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HTML

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1 Introduction

1.1 Where does this specification fit?

This specification defines a big part of the web platform, in lots of detail. Its place in the web platform specification stack relative to other specifications can be best summed up as follows:

CSS SVG MathML Service Workers

IDB Fetch CSP
AV1 Opus PNG



THIS SPECIFICATION

HTTP TLS DOM Unicode WebIDL
MIME URL XML JavaScript Encoding

1.2 Is this HTML5?

This section is non-normative.

In short: Yes.

In more length: the term "HTML5" is widely used as a buzzword to refer to modern web technologies, many of which (though by no means all) are developed at the WHATWG. This document is one such; others are available from [the WHATWG Standards overview](#).

1.3 Background

This section is non-normative.

HTML is the World Wide Web's core markup language. Originally, HTML was primarily designed as a language for semantically describing scientific documents. Its general design, however, has enabled it to be adapted, over the subsequent years, to describe a number of other types of documents and even applications.

1.4 Audience

This section is non-normative.

This specification is intended for authors of documents and scripts that use the features defined in this specification, implementers of tools that operate on pages that use the features defined in this specification, and individuals wishing to establish the correctness of documents or implementations with respect to the requirements of this specification.

This document is probably not suited to readers who do not already have at least a passing familiarity with web technologies, as in places it sacrifices clarity for precision, and brevity for completeness. More approachable tutorials and authoring guides can provide a gentler introduction to the topic.

In particular, familiarity with the basics of DOM is necessary for a complete understanding of some of the more technical parts of this specification. An understanding of Web IDL, HTTP, XML, Unicode, character encodings, JavaScript, and CSS will also be helpful in places but is not essential.

1.5 Scope

This section is non-normative.

This specification is limited to providing a semantic-level markup language and associated semantic-level scripting APIs for authoring accessible pages on the web ranging from static documents to dynamic applications.

The scope of this specification does not include providing mechanisms for media-specific customization of presentation (although default rendering rules for web browsers are included at the end of this specification, and several mechanisms for hooking into CSS are provided as part of the language).

The scope of this specification is not to describe an entire operating system. In particular, hardware configuration software, image manipulation tools, and applications that users would be expected to use with high-end workstations on a daily basis are out of scope. In terms of applications, this specification is targeted specifically at applications that would be expected to be used by users on an occasional basis, or regularly but from disparate locations, with low CPU requirements. Examples of such applications include online purchasing systems, searching systems, games (especially multiplayer online games), public telephone books or address books, communications software (email clients, instant messaging clients, discussion software), document editing software, etc.

1.6 History

This section is non-normative.

For its first five years (1990-1995), HTML went through a number of revisions and experienced a number of extensions, primarily hosted first at CERN, and then at the IETF.

With the creation of the W3C, HTML's development changed venue again. A first abortive attempt at extending HTML in 1995 known as HTML 3.0 then made way to a more pragmatic approach known as HTML 3.2, which was completed in 1997. HTML4 quickly followed later that same year.

The following year, the W3C membership decided to stop evolving HTML and instead begin work on an XML-based equivalent, called XHTML. This effort started with a reformulation of HTML4 in XML, known as XHTML 1.0, which added no new features except the new serialization, and which was completed in 2000. After XHTML 1.0, the W3C's focus turned to making it easier for other working groups to extend XHTML, under the banner of XHTML Modularization. In parallel with this, the W3C also worked on a new language that was not compatible with the earlier HTML and XHTML languages, calling it XHTML2.

Around the time that HTML's evolution was stopped in 1998, parts of the API for HTML developed by browser vendors were specified and published under the name DOM Level 1 (in 1998) and DOM Level 2 Core and DOM Level 2 HTML (starting in 2000 and culminating in 2003). These efforts then petered out, with some DOM Level 3 specifications published in 2004 but the working group being closed before all the Level 3 drafts were completed.

In 2003, the publication of XForms, a technology which was positioned as the next generation of web forms, sparked a renewed interest in evolving HTML itself, rather than finding replacements for it. This interest was borne from the realization that XML's deployment as a web technology was limited to entirely new technologies (like RSS and later Atom), rather than as a replacement for existing deployed technologies (like HTML).

A proof of concept to show that it was possible to extend HTML4's forms to provide many of the features that XForms 1.0 introduced, without requiring browsers to implement rendering engines that were incompatible with existing HTML web pages, was the first result of this renewed interest. At this early stage, while the draft was already publicly available, and input was already being solicited from all sources, the specification was only under Opera Software's copyright.

The idea that HTML's evolution should be reopened was tested at a W3C workshop in 2004, where some of the principles that underlie the HTML5 work (described below), as well as the aforementioned early draft proposal covering just forms-related features, were presented to the W3C jointly by Mozilla and Opera. The proposal was rejected on the grounds that the proposal conflicted with the previously chosen direction for the web's evolution; the W3C staff and membership voted to continue developing XML-based replacements instead.

Shortly thereafter, Apple, Mozilla, and Opera jointly announced their intent to continue

working on the effort under the umbrella of a new venue called the WHATWG. A public mailing list was created, and the draft was moved to the WHATWG site. The copyright was subsequently amended to be jointly owned by all three vendors, and to allow reuse of the specification.

The WHATWG was based on several core principles, in particular that technologies need to be backwards compatible, that specifications and implementations need to match even if this means changing the specification rather than the implementations, and that specifications need to be detailed enough that implementations can achieve complete interoperability without reverse-engineering each other.

The latter requirement in particular required that the scope of the HTML5 specification include what had previously been specified in three separate documents: HTML4, XHTML1, and DOM2 HTML. It also meant including significantly more detail than had previously been considered the norm.

In 2006, the W3C indicated an interest to participate in the development of HTML5 after all, and in 2007 formed a working group chartered to work with the WHATWG on the development of the HTML5 specification. Apple, Mozilla, and Opera allowed the W3C to publish the specification under the W3C copyright, while keeping a version with the less restrictive license on the WHATWG site.

For a number of years, both groups then worked together. In 2011, however, the groups came to the conclusion that they had different goals: the W3C wanted to publish a "finished" version of "HTML5", while the WHATWG wanted to continue working on a Living Standard for HTML, continuously maintaining the specification rather than freezing it in a state with known problems, and adding new features as needed to evolve the platform.

In 2019, the WHATWG and W3C [signed an agreement](#) to collaborate on a single version of HTML going forward: this document.

1.7 Design notes

This section is non-normative.

It must be admitted that many aspects of HTML appear at first glance to be nonsensical and inconsistent.

HTML, its supporting DOM APIs, as well as many of its supporting technologies, have been developed over a period of several decades by a wide array of people with different priorities who, in many cases, did not know of each other's existence.

Features have thus arisen from many sources, and have not always been designed in especially consistent ways. Furthermore, because of the unique characteristics of the web, implementation bugs have often become de-facto, and now de-jure, standards, as content is often unintentionally written in ways that rely on them before they can be fixed.

Despite all this, efforts have been made to adhere to certain design goals. These are described in the next few subsections.

1.7.1 Serializability of script execution

This section is non-normative.

To avoid exposing web authors to the complexities of multithreading, the HTML and DOM APIs are designed such that no script can ever detect the simultaneous execution of other scripts. Even with [workers](#), the intent is that the behavior of implementations can be thought of as completely serializing the execution of all scripts in all [browsing contexts](#).

The exception to this general design principle is the JavaScript [SharedArrayBuffer](#) class. Using [SharedArrayBuffer](#) objects, it can in fact be observed that scripts in other [agents](#) are executing simultaneously. Furthermore, due to the JavaScript memory model, there are situations which not only are un-representable via serialized *script* execution, but also un-representable via serialized *statement* execution among those scripts.

1.7.2 Compliance with other specifications

This section is non-normative.

This specification interacts with and relies on a wide variety of other specifications. In certain circumstances, unfortunately, conflicting needs have led to this specification violating the requirements of these other specifications. Whenever this has occurred, the transgressions have each been noted as a "willful violation", and the reason for the violation has been noted.

1.7.3 Extensibility

This section is non-normative.

HTML has a wide array of extensibility mechanisms that can be used for adding semantics in a safe manner:

- Authors can use the [class](#) attribute to extend elements, effectively creating their own elements, while using the most applicable existing "real" HTML element, so that browsers and other tools that don't know of the extension can still support it somewhat well. This is the tack used by microformats, for example.
- Authors can include data for inline client-side scripts or server-side site-wide scripts to process using the [data-*=""](#) attributes. These are guaranteed to never be touched by browsers, and allow scripts to include data on HTML elements that scripts can then look for and process.
- Authors can use the [`<meta name="" content="">`](#) mechanism to include page-wide metadata.

- Authors can use the `rel=""` mechanism to annotate links with specific meanings by registering [extensions to the predefined set of link types](#). This is also used by microformats.
- Authors can embed raw data using the `<script type="">` mechanism with a custom type, for further handling by inline or server-side scripts.
- Authors can extend APIs using the JavaScript prototyping mechanism. This is widely used by script libraries, for instance.
- Authors can use the microdata feature (the `itemscope=""` and `itemprop=""` attributes) to embed nested name-value pairs of data to be shared with other applications and sites.

1.8 HTML vs XML syntax

This section is non-normative.

This specification defines an abstract language for describing documents and applications, and some APIs for interacting with in-memory representations of resources that use this language.

The in-memory representation is known as "DOM HTML", or "the DOM" for short.

There are various concrete syntaxes that can be used to transmit resources that use this abstract language, two of which are defined in this specification.

The first such concrete syntax is the HTML syntax. This is the format suggested for most authors. It is compatible with most legacy web browsers. If a document is transmitted with the [text/html MIME type](#), then it will be processed as an HTML document by web browsers. This specification defines the latest HTML syntax, known simply as "HTML".

The second concrete syntax is XML. When a document is transmitted with an [XML MIME type](#), such as [application/xhtml+xml](#), then it is treated as an XML document by web browsers, to be parsed by an XML processor. Authors are reminded that the processing for XML and HTML differs; in particular, even minor syntax errors will prevent a document labeled as XML from being rendered fully, whereas they would be ignored in the HTML syntax.

The XML syntax for HTML was formerly referred to as "XHTML", but this specification does not use that term (among other reasons, because no such term is used for the HTML syntaxes of MathML and SVG).

The DOM, the HTML syntax, and the XML syntax cannot all represent the same content. For example, namespaces cannot be represented using the HTML syntax, but they are supported in the DOM and in the XML syntax. Similarly, documents that use the `noscript` feature can be represented using the HTML syntax, but cannot be represented with the DOM or in the XML syntax. Comments that contain the string "`-->`" can only be represented in the DOM, not in the HTML and XML syntaxes.

1.9 Structure of this specification

This section is non-normative.

This specification is divided into the following major sections:

Introduction

Non-normative materials providing a context for the HTML standard.

Common infrastructure

The conformance classes, algorithms, definitions, and the common underpinnings of the rest of the specification.

Semantics, structure, and APIs of HTML documents

Documents are built from elements. These elements form a tree using the DOM. This section defines the features of this DOM, as well as introducing the features common to all elements, and the concepts used in defining elements.

The elements of HTML

Each element has a predefined meaning, which is explained in this section. Rules for authors on how to use the element, along with user agent requirements for how to handle each element, are also given. This includes large signature features of HTML such as video playback and subtitles, form controls and form submission, and a 2D graphics API known as the HTML canvas.

Microdata

This specification introduces a mechanism for adding machine-readable annotations to documents, so that tools can extract trees of name-value pairs from the document. This section describes this mechanism and some algorithms that can be used to convert HTML documents into other formats. This section also defines some sample Microdata vocabularies for contact information, calendar events, and licensing works.

User interaction

HTML documents can provide a number of mechanisms for users to interact with and modify content, which are described in this section, such as how focus works, and drag-and-drop.

Loading web pages

HTML documents do not exist in a vacuum — this section defines many of the features that affect environments that deal with multiple pages, such as web browsers.

Web application APIs

This section introduces basic features for scripting of applications in HTML.

Web workers

This section defines an API for background threads in JavaScript.

[Worklets](#)

This section defines infrastructure for APIs that need to run JavaScript separately from the main JavaScript execution environment.

[The communication APIs](#)

This section describes some mechanisms that applications written in HTML can use to communicate with other applications from different domains running on the same client. It also introduces a server-push event stream mechanism known as Server Sent Events or [EventSource](#), and a two-way full-duplex socket protocol for scripts known as Web Sockets.

[Web storage](#)

This section defines a client-side storage mechanism based on name-value pairs.

[The HTML syntax](#)

[The XML syntax](#)

All of these features would be for naught if they couldn't be represented in a serialized form and sent to other people, and so these sections define the syntaxes of HTML and XML, along with rules for how to parse content using those syntaxes.

[Rendering](#)

This section defines the default rendering rules for web browsers.

There are also some appendices, listing [obsolete features](#) and [IANA considerations](#), and several indices.

1.9.1 How to read this specification

This specification should be read like all other specifications. First, it should be read cover-to-cover, multiple times. Then, it should be read backwards at least once. Then it should be read by picking random sections from the contents list and following all the cross-references.

As described in the conformance requirements section below, this specification describes conformance criteria for a variety of conformance classes. In particular, there are conformance requirements that apply to *producers*, for example authors and the documents they create, and there are conformance requirements that apply to *consumers*, for example web browsers. They can be distinguished by what they are requiring: a requirement on a producer states what is allowed, while a requirement on a consumer states how software is to act.

For example, "the **foo** attribute's value must be a [valid integer](#)" is a requirement on producers, as it lays out the allowed values; in contrast, the requirement "the **foo** attribute's value must be parsed using the [rules for parsing integers](#)" is a requirement on consumers, as it describes how to process the content.

Requirements on producers have no bearing whatsoever on consumers.

Continuing the above example, a requirement stating that a particular attribute's value is constrained to being a [valid integer](#) emphatically does *not* imply anything about the

requirements on consumers. It might be that the consumers are in fact required to treat the attribute as an opaque string, completely unaffected by whether the value conforms to the requirements or not. It might be (as in the previous example) that the consumers are required to parse the value using specific rules that define how invalid (non-numeric in this case) values are to be processed.

1.9.2 Typographic conventions

This is a definition, requirement, or explanation.

This is a note.

This is an example.

This is an open issue.

This is a warning.

```
[Exposed=Window]
interface Example {
    // this is an IDL definition
};
```

variable = object.method([optionalArgument])

This is a note to authors describing the usage of an interface.

```
/* this is a CSS fragment */
```

The defining instance of a term is marked up like *this*. Uses of that term are marked up like [this](#) or like [*this*](#).

The defining instance of an element, attribute, or API is marked up like *this*. References to that element, attribute, or API are marked up like [this](#).

Other code fragments are marked up like `this`.

Variables are marked up like *this*.

In an algorithm, steps in [synchronous sections](#) are marked with .

In some cases, requirements are given in the form of lists with conditions and corresponding requirements. In such cases, the requirements that apply to a condition are always the first set of requirements that follow the condition, even in the case of there being multiple sets of conditions for those requirements. Such cases are presented as follows:

This is a condition

This is another condition

This is the requirement that applies to the conditions above.

This is a third condition

This is the requirement that applies to the third condition.

1.10 A quick introduction to HTML

This section is non-normative.

A basic HTML document looks like this:

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <title>Sample page</title>
  </head>
  <body>
    <h1>Sample page</h1>
    <p>This is a <a href="demo.html">simple</a> sample.</p>
    <!-- this is a comment -->
  </body>
</html>
```

HTML documents consist of a tree of elements and text. Each element is denoted in the source by a start tag, such as "`<body>`", and an end tag, such as "`</body>`". (Certain start tags and end tags can in certain cases be omitted and are implied by other tags.)

Tags have to be nested such that elements are all completely within each other, without overlapping:

```
<p>This is <em>very <strong>wrong</em>!</strong></p>
<p>This <em>is <strong>correct</strong>. </em></p>
```

This specification defines a set of elements that can be used in HTML, along with rules about the ways in which the elements can be nested.

Elements can have attributes, which control how the elements work. In the example below, there is a hyperlink, formed using the `a` element and its href attribute:

```
<a href="demo.html">simple</a>
```

Attributes are placed inside the start tag, and consist of a name and a value, separated by an "`=`" character. The attribute value can remain unquoted if it doesn't contain ASCII whitespace or any of " ' ` = < or >. Otherwise, it has to be quoted using either single or double quotes. The

value, along with the "=" character, can be omitted altogether if the value is the empty string.

```
<!-- empty attributes -->
<input name=address disabled>
<input name=address disabled="">

<!-- attributes with a value -->
<input name=address maxlength=200>
<input name=address maxlength='200'>
<input name=address maxlength="200">
```

HTML user agents (e.g., web browsers) then *parse* this markup, turning it into a DOM (Document Object Model) tree. A DOM tree is an in-memory representation of a document.

DOM trees contain several kinds of nodes, in particular a [DocumentType](#) node, [Element](#) nodes, [Text](#) nodes, [Comment](#) nodes, and in some cases [ProcessingInstruction](#) nodes.

The [markup snippet at the top of this section](#) would be turned into the following DOM tree:

- DOCTYPE: `html`
- `html lang="en"`
 - `head`
 - `#text`: ↴□□
 - `title`
 - `#text`: Sample page
 - `#text`: ↴□
 - `#text`: ↴□
 - `body`
 - `#text`: ↴□□
 - `h1`
 - `#text`: Sample page
 - `#text`: ↴□□
 - `p`
 - `#text`: This is a
 - `a href="demo.html"`
 - `#text`: simple
 - `#text`: sample.
 - `#text`: ↴□□
 - `#comment`: this is a comment
 - `#text`: ↴□□

The [document element](#) of this tree is the `html` element, which is the element always found in that position in HTML documents. It contains two elements, `head` and `body`, as well as a [Text](#) node between them.

There are many more [Text](#) nodes in the DOM tree than one would initially expect, because the

source contains a number of spaces (represented here by "□") and line breaks ("↵") that all end up as **Text** nodes in the DOM. However, for historical reasons not all of the spaces and line breaks in the original markup appear in the DOM. In particular, all the whitespace before **head** start tag ends up being dropped silently, and all the whitespace after the **body** end tag ends up placed at the end of the **body**.

The **head** element contains a **title** element, which itself contains a **Text** node with the text "Sample page". Similarly, the **body** element contains an **h1** element, a **p** element, and a comment.

This DOM tree can be manipulated from scripts in the page. Scripts (typically in JavaScript) are small programs that can be embedded using the **script** element or using **event handler content attributes**. For example, here is a form with a script that sets the value of the form's **output** element to say "Hello World":

```
<form name="main">
  Result: <output name="result"></output>
  <script>
    document.forms.main.elements.result.value = 'Hello World';
  </script>
</form>
```

Each element in the DOM tree is represented by an object, and these objects have APIs so that they can be manipulated. For instance, a link (e.g. the **a** element in the tree above) can have its "**href**" attribute changed in several ways:

```
var a = document.links[0]; // obtain the first link in the document
a.href = 'sample.html'; // change the destination URL of the link
a.protocol = 'https'; // change just the scheme part of the URL
a.setAttribute('href', 'https://example.com/'); // change the content attribu
```

Since DOM trees are used as the way to represent HTML documents when they are processed and presented by implementations (especially interactive implementations like web browsers), this specification is mostly phrased in terms of DOM trees, instead of the markup described above.

HTML documents represent a media-independent description of interactive content. HTML documents might be rendered to a screen, or through a speech synthesizer, or on a braille display. To influence exactly how such rendering takes place, authors can use a styling language such as CSS.

In the following example, the page has been made yellow-on-blue using CSS.

```
<!DOCTYPE html>
<html lang="en">
```

```
<head>
  <title>Sample styled page</title>
  <style>
    body { background: navy; color: yellow; }
  </style>
</head>
<body>
  <h1>Sample styled page</h1>
  <p>This page is just a demo.</p>
</body>
</html>
```

For more details on how to use HTML, authors are encouraged to consult tutorials and guides. Some of the examples included in this specification might also be of use, but the novice author is cautioned that this specification, by necessity, defines the language with a level of detail that might be difficult to understand at first.

1.10.1 Writing secure applications with HTML

This section is non-normative.

When HTML is used to create interactive sites, care needs to be taken to avoid introducing vulnerabilities through which attackers can compromise the integrity of the site itself or of the site's users.

A comprehensive study of this matter is beyond the scope of this document, and authors are strongly encouraged to study the matter in more detail. However, this section attempts to provide a quick introduction to some common pitfalls in HTML application development.

The security model of the web is based on the concept of "origins", and correspondingly many of the potential attacks on the web involve cross-origin actions. [\[ORIGIN\]](#)

Not validating user input

Cross-site scripting (XSS)

SQL injection

When accepting untrusted input, e.g. user-generated content such as text comments, values in URL parameters, messages from third-party sites, etc, it is imperative that the data be validated before use, and properly escaped when displayed. Failing to do this can allow a hostile user to perform a variety of attacks, ranging from the potentially benign, such as providing bogus user information like a negative age, to the serious, such as running scripts every time a user looks at a page that includes the information, potentially propagating the attack in the process, to the catastrophic, such as deleting all data in the server.

When writing filters to validate user input, it is imperative that filters always be safelist-based, allowing known-safe constructs and disallowing all other input. Blocklist-based filters that disallow known-bad inputs and allow everything else are not secure, as not

everything that is bad is yet known (for example, because it might be invented in the future).

For example, suppose a page looked at its URL's query string to determine what to display, and the site then redirected the user to that page to display a message, as in:

```
<ul>
  <li><a href="message.cgi?say=Hello">Say Hello</a>
  <li><a href="message.cgi?say>Welcome">Say Welcome</a>
  <li><a href="message.cgi?say=Kittens">Say Kittens</a>
</ul>
```

If the message was just displayed to the user without escaping, a hostile attacker could then craft a URL that contained a script element:

`https://example.com/message.cgi?say=%3Cscript%3Ealert%28%270h%20no%21%27%2`

If the attacker then convinced a victim user to visit this page, a script of the attacker's choosing would run on the page. Such a script could do any number of hostile actions, limited only by what the site offers: if the site is an e-commerce shop, for instance, such a script could cause the user to unknowingly make arbitrarily many unwanted purchases.

This is called a cross-site scripting attack.

There are many constructs that can be used to try to trick a site into executing code. Here are some that authors are encouraged to consider when writing safelist filters:

- When allowing harmless-seeming elements like `img`, it is important to safelist any provided attributes as well. If one allowed all attributes then an attacker could, for instance, use the `onload` attribute to run arbitrary script.
- When allowing URLs to be provided (e.g. for links), the scheme of each URL also needs to be explicitly safelisted, as there are many schemes that can be abused. The most prominent example is "`javascript:`", but user agents can implement (and indeed, have historically implemented) others.
- Allowing a `base` element to be inserted means any `script` elements in the page with relative links can be hijacked, and similarly that any form submissions can get redirected to a hostile site.

Cross-site request forgery (CSRF)

If a site allows a user to make form submissions with user-specific side-effects, for example posting messages on a forum under the user's name, making purchases, or applying for a passport, it is important to verify that the request was made by the user intentionally, rather than by another site tricking the user into making the request unknowingly.

This problem exists because HTML forms can be submitted to other origins.

Sites can prevent such attacks by populating forms with user-specific hidden tokens, or by

checking '[Origin](#)' headers on all requests.

Clickjacking

A page that provides users with an interface to perform actions that the user might not wish to perform needs to be designed so as to avoid the possibility that users can be tricked into activating the interface.

One way that a user could be so tricked is if a hostile site places the victim site in a small [iframe](#) and then convinces the user to click, for instance by having the user play a reaction game. Once the user is playing the game, the hostile site can quickly position the iframe under the mouse cursor just as the user is about to click, thus tricking the user into clicking the victim site's interface.

To avoid this, sites that do not expect to be used in frames are encouraged to only enable their interface if they detect that they are not in a frame (e.g. by comparing the [window](#) object to the value of the [top](#) attribute).

1.10.2 Common pitfalls to avoid when using the scripting APIs

This section is non-normative.

Scripts in HTML have "run-to-completion" semantics, meaning that the browser will generally run the script uninterrupted before doing anything else, such as firing further events or continuing to parse the document.

On the other hand, parsing of HTML files happens incrementally, meaning that the parser can pause at any point to let scripts run. This is generally a good thing, but it does mean that authors need to be careful to avoid hooking event handlers after the events could have possibly fired.

There are two techniques for doing this reliably: use [event handler content attributes](#), or create the element and add the event handlers in the same script. The latter is safe because, as mentioned earlier, scripts are run to completion before further events can fire.

One way this could manifest itself is with [img](#) elements and the [load](#) event. The event could fire as soon as the element has been parsed, especially if the image has already been cached (which is common).

Here, the author uses the [onload](#) handler on an [img](#) element to catch the [load](#) event:

```

```

If the element is being added by script, then so long as the event handlers are added in the same script, the event will still not be missed:

```
<script>
```

```
var img = new Image();
img.src = 'games.png';
img.alt = 'Games';
img.onload = gamesLogoHasLoaded;
// img.addEventListener('load', gamesLogoHasLoaded, false); // would work also
</script>
```

However, if the author first created the `img` element and then in a separate script added the event listeners, there's a chance that the `load` event would be fired in between, leading it to be missed:

```
<!-- Do not use this style, it has a race condition! -->

<!-- the 'load' event might fire here while the parser is taking a
    break, in which case you will not see it! -->
<script>
  var img = document.getElementById('games');
  img.onload = gamesLogoHasLoaded; // might never fire!
</script>
```

1.10.3 How to catch mistakes when writing HTML: validators and conformance checkers

This section is non-normative.

Authors are encouraged to make use of conformance checkers (also known as *validators*) to catch common mistakes. The WHATWG maintains a list of such tools at: <https://whatwg.org/validator/>

1.11 Conformance requirements for authors

This section is non-normative.

Unlike previous versions of the HTML specification, this specification defines in some detail the required processing for invalid documents as well as valid documents.

However, even though the processing of invalid content is in most cases well-defined, conformance requirements for documents are still important: in practice, interoperability (the situation in which all implementations process particular content in a reliable and identical or equivalent way) is not the only goal of document conformance requirements. This section details some of the more common reasons for still distinguishing between a conforming document and one with errors.

1.11.1 Presentational markup

This section is non-normative.

The majority of presentational features from previous versions of HTML are no longer allowed.

Presentational markup in general has been found to have a number of problems:

The use of presentational elements leads to poorer accessibility

While it is possible to use presentational markup in a way that provides users of assistive technologies (ATs) with an acceptable experience (e.g. using ARIA), doing so is significantly more difficult than doing so when using semantically-appropriate markup. Furthermore, even using such techniques doesn't help make pages accessible for non-AT non-graphical users, such as users of text-mode browsers.

Using media-independent markup, on the other hand, provides an easy way for documents to be authored in such a way that they work for more users (e.g. users of text browsers).

Higher cost of maintenance

It is significantly easier to maintain a site written in such a way that the markup is style-independent. For example, changing the color of a site that uses `` throughout requires changes across the entire site, whereas a similar change to a site based on CSS can be done by changing a single file.

Larger document sizes

Presentational markup tends to be much more redundant, and thus results in larger document sizes.

For those reasons, presentational markup has been removed from HTML in this version. This change should not come as a surprise; HTML4 deprecated presentational markup many years ago and provided a mode (HTML4 Transitional) to help authors move away from presentational markup; later, XHTML 1.1 went further and obsoleted those features altogether.

The only remaining presentational markup features in HTML are the [style](#) attribute and the [style](#) element. Use of the [style](#) attribute is somewhat discouraged in production environments, but it can be useful for rapid prototyping (where its rules can be directly moved into a separate style sheet later) and for providing specific styles in unusual cases where a separate style sheet would be inconvenient. Similarly, the [style](#) element can be useful in syndication or for page-specific styles, but in general an external style sheet is likely to be more convenient when the styles apply to multiple pages.

It is also worth noting that some elements that were previously presentational have been redefined in this specification to be media-independent: [b](#), [i](#), [hr](#), [s](#), [small](#), and [u](#).

1.11.2 Syntax errors

This section is non-normative.

The syntax of HTML is constrained to avoid a wide variety of problems.

Unintuitive error-handling behavior

Certain invalid syntax constructs, when parsed, result in DOM trees that are highly unintuitive.

For example, the following markup fragment results in a DOM with an [hr](#) element that is an *earlier* sibling of the corresponding [table](#) element:

```
<table><hr>...
```

Errors with optional error recovery

To allow user agents to be used in controlled environments without having to implement the more bizarre and convoluted error handling rules, user agents are permitted to fail whenever encountering a [parse error](#).

Errors where the error-handling behavior is not compatible with streaming user agents

Some error-handling behavior, such as the behavior for the `<table><hr>...` example mentioned above, are incompatible with streaming user agents (user agents that process HTML files in one pass, without storing state). To avoid interoperability problems with such user agents, any syntax resulting in such behavior is considered invalid.

Errors that can result in infoset coercion

When a user agent based on XML is connected to an HTML parser, it is possible that certain invariants that XML enforces, such as element or attribute names never contain multiple colons, will be violated by an HTML file. Handling this can require that the parser coerce the HTML DOM into an XML-compatible infoset. Most syntax constructs that require such handling are considered invalid. (Comments containing two consecutive hyphens, or ending with a hyphen, are exceptions that are allowed in the HTML syntax.)

Errors that result in disproportionately poor performance

Certain syntax constructs can result in disproportionately poor performance. To discourage the use of such constructs, they are typically made non-conforming.

For example, the following markup results in poor performance, since all the unclosed [i](#) elements have to be reconstructed in each paragraph, resulting in progressively more elements in each paragraph:

```
<p><i>She dreamt.  
<p><i>She dreamt that she ate breakfast.  
<p><i>Then lunch.  
<p><i>And finally dinner.
```

The resulting DOM for this fragment would be:

- p
 - i
 - #text: She dreamt.
- p
 - i
 - i
 - #text: She dreamt that she ate breakfast.
- p
 - i
 - i
 - i
 - #text: Then lunch.
- p
 - i
 - i
 - i
 - #text: And finally dinner.

Errors involving fragile syntax constructs

There are syntax constructs that, for historical reasons, are relatively fragile. To help reduce the number of users who accidentally run into such problems, they are made non-conforming.

For example, the parsing of certain named character references in attributes happens even with the closing semicolon being omitted. It is safe to include an ampersand followed by letters that do not form a named character reference, but if the letters are changed to a string that *does* form a named character reference, they will be interpreted as that character instead.

In this fragment, the attribute's value is "?bill&ted":

```
<a href="?bill&ted">Bill and Ted</a>
```

In the following fragment, however, the attribute's value is actually "?art©", *not* the intended "?art©", because even without the final semicolon, "©" is handled the same as "©" and thus gets interpreted as "©":

```
<a href="?art&copy">Art and Copy</a>
```

To avoid this problem, all named character references are required to end with a semicolon, and uses of named character references without a semicolon are flagged as errors.

Thus, the correct way to express the above cases is as follows:

```
<a href="?bill&ted">Bill and Ted</a> <!-- &ted is ok, since it's not a nam
```

```
<a href="?art&copy">Art and Copy</a> <!-- the & has to be escaped, sin
```

Errors involving known interoperability problems in legacy user agents

Certain syntax constructs are known to cause especially subtle or serious problems in legacy user agents, and are therefore marked as non-conforming to help authors avoid them.

For example, this is why the U+0060 GRAVE ACCENT character (`) is not allowed in unquoted attributes. In certain legacy user agents, it is sometimes treated as a quote character.

Another example of this is the DOCTYPE, which is required to trigger [no-quirks mode](#), because the behavior of legacy user agents in [quirks mode](#) is often largely undocumented.

Errors that risk exposing authors to security attacks

Certain restrictions exist purely to avoid known security problems.

For example, the restriction on using UTF-7 exists purely to avoid authors falling prey to a known cross-site-scripting attack using UTF-7. [\[UTF7\]](#)

Cases where the author's intent is unclear

Markup where the author's intent is very unclear is often made non-conforming. Correcting these errors early makes later maintenance easier.

For example, it is unclear whether the author intended the following to be an [h1](#) heading or an [h2](#) heading:

```
<h1>Contact details</h2>
```

Cases that are likely to be typos

When a user makes a simple typo, it is helpful if the error can be caught early, as this can save the author a lot of debugging time. This specification therefore usually considers it an error to use element names, attribute names, and so forth, that do not match the names defined in this specification.

For example, if the author typed `<caption>` instead of `<caption>`, this would be flagged as an error and the author could correct the typo immediately.

Errors that could interfere with new syntax in the future

In order to allow the language syntax to be extended in the future, certain otherwise harmless features are disallowed.

For example, "attributes" in end tags are ignored currently, but they are invalid, in case a

future change to the language makes use of that syntax feature without conflicting with already-deployed (and valid!) content.

Some authors find it helpful to be in the practice of always quoting all attributes and always including all optional tags, preferring the consistency derived from such custom over the minor benefits of terseness afforded by making use of the flexibility of the HTML syntax. To aid such authors, conformance checkers can provide modes of operation wherein such conventions are enforced.

1.11.3 Restrictions on content models and on attribute values

This section is non-normative.

Beyond the syntax of the language, this specification also places restrictions on how elements and attributes can be specified. These restrictions are present for similar reasons:

Errors involving content with dubious semantics

To avoid misuse of elements with defined meanings, content models are defined that restrict how elements can be nested when such nestings would be of dubious value.

For example, this specification disallows nesting a [section](#) element inside a [kbd](#) element, since it is highly unlikely for an author to indicate that an entire section should be keyed in.

Errors that involve a conflict in expressed semantics

Similarly, to draw the author's attention to mistakes in the use of elements, clear contradictions in the semantics expressed are also considered conformance errors.

In the fragments below, for example, the semantics are nonsensical: a separator cannot simultaneously be a cell, nor can a radio button be a progress bar.

```
<hr role="cell">  
<input type=radio role=progressbar>
```

Another example is the restrictions on the content models of the [ul](#) element, which only allows [li](#) element children. Lists by definition consist just of zero or more list items, so if a [ul](#) element contains something other than an [li](#) element, it's not clear what was meant.

Cases where the default styles are likely to lead to confusion

Certain elements have default styles or behaviors that make certain combinations likely to lead to confusion. Where these have equivalent alternatives without this problem, the confusing combinations are disallowed.

For example, [div](#) elements are rendered as [block boxes](#), and [span](#) elements as [inline boxes](#).

Putting a [block box](#) in an [inline box](#) is unnecessarily confusing; since either nesting just [div](#) elements, or nesting just [span](#) elements, or nesting [span](#) elements inside [div](#) elements all serve the same purpose as nesting a [div](#) element in a [span](#) element, but only the latter involves a [block box](#) in an [inline box](#), the latter combination is disallowed.

Another example would be the way [interactive content](#) cannot be nested. For example, a [button](#) element cannot contain a [textarea](#) element. This is because the default behavior of such nesting interactive elements would be highly confusing to users. Instead of nesting these elements, they can be placed side by side.

Errors that indicate a likely misunderstanding of the specification

Sometimes, something is disallowed because allowing it would likely cause author confusion.

For example, setting the [disabled](#) attribute to the value "[false](#)" is disallowed, because despite the appearance of meaning that the element is enabled, it in fact means that the element is *disabled* (what matters for implementations is the presence of the attribute, not its value).

Errors involving limits that have been imposed merely to simplify the language

Some conformance errors simplify the language that authors need to learn.

For example, the [area](#) element's [shape](#) attribute, despite accepting both [circ](#) and [circle](#) values in practice as synonyms, disallows the use of the [circ](#) value, so as to simplify tutorials and other learning aids. There would be no benefit to allowing both, but it would cause extra confusion when teaching the language.

Errors that involve peculiarities of the parser

Certain elements are parsed in somewhat eccentric ways (typically for historical reasons), and their content model restrictions are intended to avoid exposing the author to these issues.

For example, a [form](#) element isn't allowed inside [phrasing content](#), because when parsed as HTML, a [form](#) element's start tag will imply a [p](#) element's end tag. Thus, the following markup results in two [paragraphs](#), not one:

```
<p>Welcome. <form><label>Name:</label> <input></form>
```

It is parsed exactly like the following:

```
<p>Welcome. </p><form><label>Name:</label> <input></form>
```

Errors that would likely result in scripts failing in hard-to-debug ways

Some errors are intended to help prevent script problems that would be hard to debug.

This is why, for instance, it is non-conforming to have two `id` attributes with the same value. Duplicate IDs lead to the wrong element being selected, with sometimes disastrous effects whose cause is hard to determine.

Errors that waste authoring time

Some constructs are disallowed because historically they have been the cause of a lot of wasted authoring time, and by encouraging authors to avoid making them, authors can save time in future efforts.

For example, a `script` element's `src` attribute causes the element's contents to be ignored. However, this isn't obvious, especially if the element's contents appear to be executable script — which can lead to authors spending a lot of time trying to debug the inline script without realizing that it is not executing. To reduce this problem, this specification makes it non-conforming to have executable script in a `script` element when the `src` attribute is present. This means that authors who are validating their documents are less likely to waste time with this kind of mistake.

Errors that involve areas that affect authors migrating between the HTML and XML syntaxes

Some authors like to write files that can be interpreted as both XML and HTML with similar results. Though this practice is discouraged in general due to the myriad of subtle complications involved (especially when involving scripting, styling, or any kind of automated serialization), this specification has a few restrictions intended to at least somewhat mitigate the difficulties. This makes it easier for authors to use this as a transitional step when migrating between the HTML and XML syntaxes.

For example, there are somewhat complicated rules surrounding the `lang` and `xml:lang` attributes intended to keep the two synchronized.

Another example would be the restrictions on the values of `xmlns` attributes in the HTML serialization, which are intended to ensure that elements in conforming documents end up in the same namespaces whether processed as HTML or XML.

Errors that involve areas reserved for future expansion

As with the restrictions on the syntax intended to allow for new syntax in future revisions of the language, some restrictions on the content models of elements and values of attributes are intended to allow for future expansion of the HTML vocabulary.

For example, limiting the values of the `target` attribute that start with an U+005F LOW LINE character (_) to only specific predefined values allows new predefined values to be introduced at a future time without conflicting with author-defined values.

Errors that indicate a mis-use of other specifications

Certain restrictions are intended to support the restrictions made by other specifications.

For example, requiring that attributes that take media query lists use only *valid* media query lists reinforces the importance of following the conformance rules of that specification.

1.12 Suggested reading

This section is non-normative.

The following documents might be of interest to readers of this specification.

Character Model for the World Wide Web 1.0: Fundamentals [[CHARMOD](#)]

This Architectural Specification provides authors of specifications, software developers, and content developers with a common reference for interoperable text manipulation on the World Wide Web, building on the Universal Character Set, defined jointly by the Unicode Standard and ISO/IEC 10646. Topics addressed include use of the terms 'character', 'encoding' and 'string', a reference processing model, choice and identification of character encodings, character escaping, and string indexing.

Unicode Security Considerations [[UTR36](#)]

Because Unicode contains such a large number of characters and incorporates the varied writing systems of the world, incorrect usage can expose programs or systems to possible security attacks. This is especially important as more and more products are internationalized. This document describes some of the security considerations that programmers, system analysts, standards developers, and users should take into account, and provides specific recommendations to reduce the risk of problems.

Web Content Accessibility Guidelines (WCAG) [[WCAG](#)]

Web Content Accessibility Guidelines (WCAG) covers a wide range of recommendations for making web content more accessible. Following these guidelines will make content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these. Following these guidelines will also often make your web content more usable to users in general.

Authoring Tool Accessibility Guidelines (ATAG) 2.0 [[ATAG](#)]

This specification provides guidelines for designing web content authoring tools that are more accessible for people with disabilities. An authoring tool that conforms to these guidelines will promote accessibility by providing an accessible user interface to authors with disabilities as well as by enabling, supporting, and promoting the production of accessible web content by all authors.

User Agent Accessibility Guidelines (UAAG) 2.0 [UAAG]

This document provides guidelines for designing user agents that lower barriers to web accessibility for people with disabilities. User agents include browsers and other types of software that retrieve and render web content. A user agent that conforms to these guidelines will promote accessibility through its own user interface and through other internal facilities, including its ability to communicate with other technologies (especially assistive technologies). Furthermore, all users, not just users with disabilities, should find conforming user agents to be more usable.

2 Common infrastructure

This specification depends on *Infra*. [INFRA]

2.1 Terminology

This specification refers to both HTML and XML attributes and IDL attributes, often in the same context. When it is not clear which is being referred to, they are referred to as *content attributes* for HTML and XML attributes, and *IDL attributes* for those defined on IDL interfaces. Similarly, the term "properties" is used for both JavaScript object properties and CSS properties. When these are ambiguous they are qualified as *object properties* and *CSS properties* respectively.

Generally, when the specification states that a feature applies to [the HTML syntax](#) or [the XML syntax](#), it also includes the other. When a feature specifically only applies to one of the two languages, it is called out by explicitly stating that it does not apply to the other format, as in "for HTML, ... (this does not apply to XML)".

This specification uses the term *document* to refer to any use of HTML, ranging from short static documents to long essays or reports with rich multimedia, as well as to fully-fledged interactive applications. The term is used to refer both to [Document](#) objects and their descendant DOM trees, and to serialized byte streams using the [HTML syntax](#) or the [XML syntax](#), depending on context.

In the context of the DOM structures, the terms [HTML document](#) and [XML document](#) are used as defined in *DOM*, and refer specifically to two different modes that [Document](#) objects can find themselves in. [DOM] (Such uses are always hyperlinked to their definition.)

In the context of byte streams, the term HTML document refers to resources labeled as [text/html](#), and the term XML document refers to resources labeled with an [XML MIME type](#).

For simplicity, terms such as *shown*, *displayed*, and *visible* might sometimes be used when referring to the way a document is rendered to the user. These terms are not meant to imply a visual medium; they must be considered to apply to other media in equivalent ways.

2.1.1 Parallelism

To run steps *in parallel* means those steps are to be run, one after another, at the same time as other logic in the standard (e.g., at the same time as the [event loop](#)). This standard does not define the precise mechanism by which this is achieved, be it time-sharing cooperative multitasking, fibers, threads, processes, using different hyperthreads, cores, CPUs, machines, etc. By contrast, an operation that is to run *immediately* must interrupt the currently running task, run itself, and then resume the previously running task.

For guidance on writing specifications that leverage parallelism, see [Dealing with the event loop from other specifications](#).

To avoid race conditions between different [in parallel](#) algorithms that operate on the same data, a [parallel queue](#) can be used.

A *parallel queue* represents a queue of algorithm steps that must be run in series.

A [parallel queue](#) has an *algorithm queue* (a [queue](#)), initially empty.

To *enqueue steps* to a [parallel queue](#), [enqueue](#) the algorithm steps to the [parallel queue's algorithm queue](#).

To *start a new parallel queue*, run the following steps:

1. Let *parallelQueue* be a new [parallel queue](#).
2. Run the following steps [in parallel](#):
 1. While true:
 1. Let *steps* be the result of [dequeuing](#) from *parallelQueue*'s [algorithm queue](#).
 2. If *steps* is not nothing, then run *steps*.
 3. Assert: running *steps* did not throw an exception, as steps running [in parallel](#) are not allowed to throw.
 3. Return *parallelQueue*.

Implementations are not expected to implement this as a continuously running loop. Algorithms in standards are to be easy to understand and are not necessarily great for battery life or performance.

Steps running [in parallel](#) can themselves run other steps in [in parallel](#). E.g., inside a [parallel queue](#) it can be useful to run a series of steps in parallel with the queue.

Imagine a standard defined *nameList* (a [list](#)), along with a method to add a *name* to *nameList*,

unless *nameList* already [contains](#) *name*, in which case it rejects.

The following solution suffers from race conditions:

1. Let *p* be a new promise.
2. Run the following steps [in parallel](#):
 1. If *nameList* [contains](#) *name*, reject *p* with a [TypeError](#) and abort these steps.
 2. Do some potentially lengthy work.
 3. [Append](#) *name* to *nameList*.
 4. Resolve *p* with undefined.
3. Return *p*.

Two invocations of the above could run simultaneously, meaning *name* isn't in *nameList* during step 2.1, but it *might be added* before step 2.3 runs, meaning *name* ends up in *nameList* twice.

Parallel queues solve this. The standard would let *nameListQueue* be the result of [starting a new parallel queue](#), then:

1. Let *p* be a new promise.
2. [Enqueue the following steps](#) to *nameListQueue*:
 1. If *nameList* [contains](#) *name*, reject *p* with a [TypeError](#) and abort these steps.
 2. Do some potentially lengthy work.
 3. [Append](#) *name* to *nameList*.
 4. Resolve *p* with undefined.
3. Return *p*.

The steps would now queue and the race is avoided.

2.1.2 Resources

The specification uses the term *supported* when referring to whether a user agent has an implementation capable of decoding the semantics of an external resource. A format or type is said to be *supported* if the implementation can process an external resource of that format or type without critical aspects of the resource being ignored. Whether a specific resource is *supported* can depend on what features of the resource's format are in use.

For example, a PNG image would be considered to be in a supported format if its pixel data could be decoded and rendered, even if, unbeknownst to the implementation, the image also contained animation data.

An MPEG-4 video file would not be considered to be in a supported format if the compression format used was not supported, even if the implementation could determine the dimensions of the movie from the file's metadata.

What some specifications, in particular the HTTP specifications, refer to as a *representation* is referred to in this specification as a *resource*. [\[HTTP\]](#)

A resource's *critical subresources* are those that the resource needs to have available to be correctly processed. Which resources are considered critical or not is defined by the specification that defines the resource's format.

For [CSS style sheets](#), we tentatively define here that their critical subresources are other style sheets imported via `@import` rules, including those indirectly imported by other imported style sheets.

This definition is not fully interoperable; furthermore, some user agents seem to count resources like background images or web fonts as critical subresources. Ideally, the CSS Working Group would define this; see [w3c/csswg-drafts issue #1088](#) to track progress on that front.

2.1.3 XML compatibility

To ease migration from HTML to XML, user agents conforming to this specification will place elements in HTML in the <http://www.w3.org/1999/xhtml> namespace, at least for the purposes of the DOM and CSS. The term "*HTML elements*" refers to any element in that namespace, even in XML documents.

Except where otherwise stated, all elements defined or mentioned in this specification are in the [HTML namespace](#) ("<http://www.w3.org/1999/xhtml>"), and all attributes defined or mentioned in this specification have no namespace.

The term *element type* is used to refer to the set of elements that have a given local name and namespace. For example, [button](#) elements are elements with the element type [button](#), meaning they have the local name "**button**" and (implicitly as defined above) the [HTML namespace](#).

Attribute names are said to be *XML-compatible* if they match the [Name](#) production defined in XML and they contain no U+003A COLON characters (:). [\[XML\]](#)

2.1.4 DOM trees

When it is stated that some element or attribute is *ignored*, or treated as some other value, or handled as if it was something else, this refers only to the processing of the node after it is in the DOM. A user agent must not mutate the DOM in such situations.

A content attribute is said to *change* value only if its new value is different than its previous value; setting an attribute to a value it already has does not change it.

The term *empty*, when used for an attribute value, [Text](#) node, or string, means that the [length](#) of the text is zero (i.e., not even containing [controls](#) or U+0020 SPACE).

A *node A is inserted* into a node *B* when the [insertion steps](#) are invoked with *A* as the argument and *A*'s new parent is *B*. Similarly, a *node A is removed* from a node *B* when the [removing steps](#) are invoked with *A* as the *removedNode* argument and *B* as the *oldParent* argument.

A *node is inserted into a document* when the [insertion steps](#) are invoked with it as the argument and it is now [in a document tree](#). Analogously, a *node is removed from a document* when the [removing steps](#) are invoked with it as the argument and it is now no longer [in a document tree](#).

A node *becomes connected* when the [insertion steps](#) are invoked with it as the argument and it is now [connected](#). Analogously, a node *becomes disconnected* when the [removing steps](#) are invoked with it as the argument and it is now no longer [connected](#).

A node is *browsing-context connected* when it is [connected](#) and its [shadow-including root's browsing context](#) is non-null. A node *becomes browsing-context connected* when the [insertion steps](#) are invoked with it as the argument and it is now [browsing-context connected](#). A node *becomes browsing-context disconnected* either when the [removing steps](#) are invoked with it as the argument and it is now no longer [browsing-context connected](#), or when its [shadow-including root's browsing context](#) becomes null.

2.1.5 Scripting

The construction "a **Foo** object", where **Foo** is actually an interface, is sometimes used instead of the more accurate "an object implementing the interface **Foo**".

An IDL attribute is said to be *getting* when its value is being retrieved (e.g. by author script), and is said to be *setting* when a new value is assigned to it.

If a DOM object is said to be *live*, then the attributes and methods on that object must operate on the actual underlying data, not a snapshot of the data.

2.1.6 Plugins

The term *plugin* refers to an [implementation-defined](#) set of content handlers used by the user agent that can take part in the user agent's rendering of a [Document](#) object, but that neither act as [child browsing contexts](#) of the [Document](#) nor introduce any [Node](#) objects to the [Document](#)'s DOM.

Typically such content handlers are provided by third parties, though a user agent can also designate built-in content handlers as plugins.

A user agent must not consider the types [text/plain](#) and [application/octet-stream](#) as

having a registered [plugin](#).

One example of a plugin would be a PDF viewer that is instantiated in a [browsing context](#) when the user navigates to a PDF file. This would count as a plugin regardless of whether the party that implemented the PDF viewer component was the same as that which implemented the user agent itself. However, a PDF viewer application that launches separate from the user agent (as opposed to using the same interface) is not a plugin by this definition.

This specification does not define a mechanism for interacting with plugins, as it is expected to be user-agent- and platform-specific. Some UAs might opt to support a plugin mechanism such as the Netscape Plugin API; others might use remote content converters or have built-in support for certain types. Indeed, this specification doesn't require user agents to support plugins at all. [\[NPAPI\]](#)

Browsers should take extreme care when interacting with external content intended for [plugins](#). When third-party software is run with the same privileges as the user agent itself, vulnerabilities in the third-party software become as dangerous as those in the user agent.

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Since different users having different sets of [plugins](#) provides a tracking vector that increases the chances of users being uniquely identified, user agents are encouraged to support the exact same set of [plugins](#) for each user.

2.1.7 Character encodings

A [character encoding](#), or just *encoding* where that is not ambiguous, is a defined way to convert between byte streams and Unicode strings, as defined in *Encoding*. An [encoding](#) has an [encoding name](#) and one or more [encoding labels](#), referred to as the encoding's *name* and *labels* in the Encoding standard. [\[ENCODING\]](#)

2.1.8 Conformance classes

This specification describes the conformance criteria for user agents (relevant to implementers) and documents (relevant to authors and authoring tool implementers).

Conforming documents are those that comply with all the conformance criteria for documents. For readability, some of these conformance requirements are phrased as conformance requirements on authors; such requirements are implicitly requirements on documents: by definition, all documents are assumed to have had an author. (In some cases, that author may itself be a user agent — such user agents are subject to additional rules, as explained below.)

For example, if a requirement states that "authors must not use the **foobar** element", it would imply that documents are not allowed to contain elements named **foobar**.

There is no implied relationship between document conformance requirements and

implementation conformance requirements. User agents are not free to handle non-conformant documents as they please; the processing model described in this specification applies to implementations regardless of the conformity of the input documents.

User agents fall into several (overlapping) categories with different conformance requirements.

Web browsers and other interactive user agents

Web browsers that support [the XML syntax](#) must process elements and attributes from the [HTML namespace](#) found in XML documents as described in this specification, so that users can interact with them, unless the semantics of those elements have been overridden by other specifications.

A conforming web browser would, upon finding a [script](#) element in an XML document, execute the script contained in that element. However, if the element is found within a transformation expressed in XSLT (assuming the user agent also supports XSLT), then the processor would instead treat the [script](#) element as an opaque element that forms part of the transform.

Web browsers that support [the HTML syntax](#) must process documents labeled with an [HTML MIME type](#) as described in this specification, so that users can interact with them.

User agents that support scripting must also be conforming implementations of the IDL fragments in this specification, as described in *Web IDL*. [\[WEBIDL\]](#)

Unless explicitly stated, specifications that override the semantics of HTML elements do not override the requirements on DOM objects representing those elements. For example, the [script](#) element in the example above would still implement the [HTMLScriptElement](#) interface.

Non-interactive presentation user agents

User agents that process HTML and XML documents purely to render non-interactive versions of them must comply to the same conformance criteria as web browsers, except that they are exempt from requirements regarding user interaction.

Typical examples of non-interactive presentation user agents are printers (static UAs) and overhead displays (dynamic UAs). It is expected that most static non-interactive presentation user agents will also opt to [lack scripting support](#).

A non-interactive but dynamic presentation UA would still execute scripts, allowing forms to be dynamically submitted, and so forth. However, since the concept of "focus" is irrelevant when the user cannot interact with the document, the UA would not need to support any of the focus-related DOM APIs.

Visual user agents that support the suggested default rendering

User agents, whether interactive or not, may be designated (possibly as a user option) as

supporting the suggested default rendering defined by this specification.

This is not required. In particular, even user agents that do implement the suggested default rendering are encouraged to offer settings that override this default to improve the experience for the user, e.g. changing the color contrast, using different focus styles, or otherwise making the experience more accessible and usable to the user.

User agents that are designated as supporting the suggested default rendering must, while so designated, implement the rules [the Rendering section](#) defines as the behavior that user agents are *expected* to implement.

User agents with no scripting support

Implementations that do not support scripting (or which have their scripting features disabled entirely) are exempt from supporting the events and DOM interfaces mentioned in this specification. For the parts of this specification that are defined in terms of an events model or in terms of the DOM, such user agents must still act as if events and the DOM were supported.

Scripting can form an integral part of an application. Web browsers that do not support scripting, or that have scripting disabled, might be unable to fully convey the author's intent.

Conformance checkers

Conformance checkers must verify that a document conforms to the applicable conformance criteria described in this specification. Automated conformance checkers are exempt from detecting errors that require interpretation of the author's intent (for example, while a document is non-conforming if the content of a [blockquote](#) element is not a quote, conformance checkers running without the input of human judgement do not have to check that [blockquote](#) elements only contain quoted material).

Conformance checkers must check that the input document conforms when parsed without a [browsing context](#) (meaning that no scripts are run, and that the parser's [scripting flag](#) is disabled), and should also check that the input document conforms when parsed with a [browsing context](#) in which scripts execute, and that the scripts never cause non-conforming states to occur other than transiently during script execution itself. (This is only a "SHOULD" and not a "MUST" requirement because it has been proven to be impossible. [\[COMPUTABLE\]](#))

The term "HTML validator" can be used to refer to a conformance checker that itself conforms to the applicable requirements of this specification.

XML DTDs cannot express all the conformance requirements of this specification. Therefore, a validating XML processor and a DTD cannot constitute a conformance checker. Also, since neither of the two authoring formats defined in this specification are applications of SGML, a validating SGML system cannot constitute a conformance checker either.

To put it another way, there are three types of conformance criteria:

1. Criteria that can be expressed in a DTD.
2. Criteria that cannot be expressed by a DTD, but can still be checked by a machine.
3. Criteria that can only be checked by a human.

A conformance checker must check for the first two. A simple DTD-based validator only checks for the first class of errors and is therefore not a conforming conformance checker according to this specification.

Data mining tools

Applications and tools that process HTML and XML documents for reasons other than to either render the documents or check them for conformance should act in accordance with the semantics of the documents that they process.

A tool that generates [document outlines](#) but increases the nesting level for each paragraph and does not increase the nesting level for each section would not be conforming.

Authoring tools and markup generators

Authoring tools and markup generators must generate [conforming documents](#).

Conformance criteria that apply to authors also apply to authoring tools, where appropriate.

Authoring tools are exempt from the strict requirements of using elements only for their specified purpose, but only to the extent that authoring tools are not yet able to determine author intent. However, authoring tools must not automatically misuse elements or encourage their users to do so.

For example, it is not conforming to use an [address](#) element for arbitrary contact information; that element can only be used for marking up contact information for its nearest [article](#) or [body](#) element ancestor. However, since an authoring tool is likely unable to determine the difference, an authoring tool is exempt from that requirement. This does not mean, though, that authoring tools can use [address](#) elements for any block of italics text (for instance); it just means that the authoring tool doesn't have to verify that when the user uses a tool for inserting contact information for an [article](#) element, that the user really is doing that and not inserting something else instead.

In terms of conformance checking, an editor has to output documents that conform to the same extent that a conformance checker will verify.

When an authoring tool is used to edit a non-conforming document, it may preserve the conformance errors in sections of the document that were not edited during the editing session (i.e. an editing tool is allowed to round-trip erroneous content). However, an authoring tool must not claim that the output is conformant if errors have been so preserved.

Authoring tools are expected to come in two broad varieties: tools that work from structure or semantic data, and tools that work on a What-You-See-Is-What-You-Get media-specific editing basis (WYSIWYG).

The former is the preferred mechanism for tools that author HTML, since the structure in the source information can be used to make informed choices regarding which HTML elements and attributes are most appropriate.

However, WYSIWYG tools are legitimate. WYSIWYG tools should use elements they know are appropriate, and should not use elements that they do not know to be appropriate. This might in certain extreme cases mean limiting the use of flow elements to just a few elements, like [div](#), [b](#), [i](#), and [span](#) and making liberal use of the [style](#) attribute.

All authoring tools, whether WYSIWYG or not, should make a best effort attempt at enabling users to create well-structured, semantically rich, media-independent content.

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[vector.](#)) User agents may impose implementation-specific limits on otherwise unconstrained inputs, e.g., to prevent denial of service attacks, to guard against running out of memory, or to work around platform-specific limitations.

For compatibility with existing content and prior specifications, this specification describes two authoring formats: one based on [XML](#), and one using a [custom format](#) inspired by SGML (referred to as [the HTML syntax](#)). Implementations must support at least one of these two formats, although supporting both is encouraged.

Some conformance requirements are phrased as requirements on elements, attributes, methods or objects. Such requirements fall into two categories: those describing content model restrictions, and those describing implementation behavior. Those in the former category are requirements on documents and authoring tools. Those in the second category are requirements on user agents. Similarly, some conformance requirements are phrased as requirements on authors; such requirements are to be interpreted as conformance requirements on the documents that authors produce. (In other words, this specification does not distinguish between conformance criteria on authors and conformance criteria on documents.)

2.1.9 Dependencies

This specification relies on several other underlying specifications.

Infra

The following terms are defined in *Infra*: [\[INFRA\]](#)

- The general iteration terms [while](#), [continue](#), and [break](#).
- [implementation-defined](#)
- [tracking vector](#)

- [code point](#) and its synonym [character](#)
- [surrogate](#)
- [scalar value](#)
- [tuple](#)
- [noncharacter](#)
- [string](#), [code unit](#), [length](#), and [code point length](#)
- The string equality operations [is](#) and [identical to](#)
- [scalar value string](#)
- [convert](#)
- [ASCII string](#)
- [ASCII whitespace](#)
- [control](#)
- [ASCII digit](#)
- [ASCII upper hex digit](#)
- [ASCII lower hex digit](#)
- [ASCII hex digit](#)
- [ASCII upper alpha](#)
- [ASCII lower alpha](#)
- [ASCII alpha](#)
- [ASCII alphanumeric](#)
- [isomorphic decode](#)
- [isomorphic encode](#)
- [ASCII lowercase](#)
- [ASCII uppercase](#)
- [ASCII case-insensitive](#)
- [strip newlines](#)
- [normalize newlines](#)
- [strip leading and trailing ASCII whitespace](#)
- [strip and collapse ASCII whitespace](#)
- [split a string on ASCII whitespace](#)
- [split a string on commas](#)
- [collect a sequence of code points](#) and its associated [position variable](#)
- [skip ASCII whitespace](#)
- The [ordered map](#) data structure and the associated definitions for [key](#), [value](#), [empty](#), [entry](#), [exists](#), [getting the value of an entry](#), [setting the value of an entry](#), [removing an entry](#), [clear](#), [getting the keys](#), [getting the values](#), [size](#), and [iterate](#)
- The [list](#) data structure and the associated definitions for [append](#), [extend](#), [replace](#), [remove](#), [empty](#), [contains](#), [size](#), [indices](#), [is empty](#), [iterate](#), and [clone](#)
- The [stack](#) data structure and the associated definitions for [push](#) and [pop](#)
- The [queue](#) data structure and the associated definitions for [enqueue](#) and [dequeue](#)
- The [ordered set](#) data structure and the associated definition for [append](#) and [union](#)
- The [struct](#) specification type and the associated definition for [item](#)
- The [forgiving-base64 encode](#) and [forgiving-base64 decode](#) algorithms
- [HTML namespace](#)
- [MathML namespace](#)
- [SVG namespace](#)
- [XLink namespace](#)

- [XML namespace](#)
- [XMLNS namespace](#)

Unicode and Encoding

The Unicode character set is used to represent textual data, and *Encoding* defines requirements around [character encodings](#). [\[UNICODE\]](#)

This specification [introduces terminology](#) based on the terms defined in those specifications, as described earlier.

The following terms are used as defined in *Encoding*: [\[ENCODING\]](#)

- [Getting an encoding](#)
- [Get an output encoding](#)
- The generic [decode](#) algorithm which takes a byte stream and an encoding and returns a character stream
- The [UTF-8 decode](#) algorithm which takes a byte stream and returns a character stream, additionally stripping one leading UTF-8 Byte Order Mark (BOM), if any
- The [UTF-8 decode without BOM](#) algorithm which is identical to [UTF-8 decode](#) except that it does not strip one leading UTF-8 Byte Order Mark (BOM)
- The [encode](#) algorithm which takes a character stream and an encoding and returns a byte stream
- The [UTF-8 encode](#) algorithm which takes a character stream and returns a byte stream
- The [BOM sniff](#) algorithm which takes a byte stream and returns an encoding or null.

XML and related specifications

Implementations that support [the XML syntax](#) for HTML must support some version of XML, as well as its corresponding namespaces specification, because that syntax uses an XML serialization with namespaces. [\[XML\]](#) [\[XMLNS\]](#)

Data mining tools and other user agents that perform operations on content without running scripts, evaluating CSS or XPath expressions, or otherwise exposing the resulting DOM to arbitrary content, may "support namespaces" by just asserting that their DOM node analogues are in certain namespaces, without actually exposing the namespace strings.

In [the HTML syntax](#), namespace prefixes and namespace declarations do not have the same effect as in XML. For instance, the colon has no special meaning in HTML element names.

The attribute with the name [space](#) in the [XML namespace](#) is defined by *Extensible Markup Language (XML)*. [\[XML\]](#)

The [Name](#) production is defined in *XML*. [\[XML\]](#)

This specification also references the `<?xml-stylesheet?>` processing instruction, defined in *Associating Style Sheets with XML documents*. [XMLSSPI]

This specification also non-normatively mentions the *XSLTProcessor* interface and its `transformToFragment()` and `transformToDocument()` methods. [XSLTP]

URLs

The following terms are defined in *URL*: [URL]

- [*host*](#)
- [*public suffix*](#)
- [*domain*](#)
- [*IP address*](#)
- [*URL*](#)
- [*Origin* of URLs](#)
- [*Absolute URL*](#)
- [*Relative URL*](#)
- [*registrable domain*](#)
- The [*URL parser*](#)
- The [*basic URL parser*](#) and its `url` and `state override` arguments, as well as these parser states:
 - [*scheme start state*](#)
 - [*host state*](#)
 - [*hostname state*](#)
 - [*port state*](#)
 - [*path start state*](#)
 - [*query state*](#)
 - [*fragment state*](#)
- [*URL record*](#), as well as its individual components:
 - [*scheme*](#)
 - [*username*](#)
 - [*password*](#)
 - [*host*](#)
 - [*port*](#)
 - [*path*](#)
 - [*query*](#)
 - [*fragment*](#)
 - [*blob URL entry*](#)
- [*valid URL string*](#)
- The [*cannot have a username/password/port*](#) concept
- The [*opaque path*](#) concept
- [*URL serializer*](#) and its `exclude fragment` argument
- [*URL path serializer*](#)
- The [*host parser*](#)
- The [*host serializer*](#)
- [*Host equals*](#)

- [URL equals](#) and its [exclude fragments](#) argument
- [serialize an integer](#)
- [Default encode set](#)
- [component percent-encode set](#)
- [UTF-8 percent-encode](#)
- [percent-decode](#)
- [set the username](#)
- [set the password](#)
- The [application/x-www-form-urlencoded](#) format
- The [application/x-www-form-urlencoded serializer](#)

A number of schemes and protocols are referenced by this specification also:

- The [about:](#) scheme [\[ABOUT\]](#)
- The [blob:](#) scheme [\[FILEAPI\]](#)
- The [data:](#) scheme [\[RFC2397\]](#)
- The [http:](#) scheme [\[HTTP\]](#)
- The [https:](#) scheme [\[HTTP\]](#)
- The [mailto:](#) scheme [\[MAILTO\]](#)
- The [sms:](#) scheme [\[SMS\]](#)
- The [urn:](#) scheme [\[URN\]](#)

[Media fragment syntax](#) is defined in *Media Fragments URI*. [\[MEDIAFRAG\]](#)

HTTP and related specifications

The following terms are defined in the HTTP specifications: [\[HTTP\]](#)

- [`Accept`](#) header
- [`Accept-Language`](#) header
- [`Cache-Control`](#) header
- [`Content-Disposition`](#) header
- [`Content-Language`](#) header
- [`Last-Modified`](#) header
- [`Referer`](#) header

The following terms are defined in *HTTP State Management Mechanism*: [\[COOKIES\]](#)

- [cookie-string](#)
- [receives a set-cookie-string](#)
- [`Cookie`](#) header

The following term is defined in *Web Linking*: [\[WEBLINK\]](#)

- [`Link`](#) header

The following terms are defined in *Structured Field Values for HTTP*: [\[STRUCTURED-\]](#)

FIELDS]

- structured header
- boolean
- token
- parameters

The following terms are defined in *MIME Sniffing*: [\[MIMESNIFF\]](#)

- MIME type
- MIME type essence
- valid MIME type string
- valid MIME type string with no parameters
- HTML MIME type
- JavaScript MIME type and JavaScript MIME type essence match
- JSON MIME type
- XML MIME type

Fetch

The following terms are defined in *Fetch*: [\[FETCH\]](#)

- ABNF
- about:blank
- An HTTP(S) scheme
- A URL which is local
- A local scheme
- A fetch scheme
- CORS protocol
- default 'User-Agent' value
- extract a MIME type
- fetch
- HTTP-redirect fetch
- ok status
- navigation request
- network error
- 'Origin' header
- 'Cross-Origin-Resource-Policy' header
- process response
- getting a structured field value
- set
- get, decode, and split
- terminate
- cross-origin resource policy check
- the RequestCredentials enumeration
- the RequestDestination enumeration
- the fetch() method

- [serialize a response URL for reporting](#)
- [response](#) and its associated:
 - [type](#)
 - [URL](#)
 - [URL list](#)
 - [status](#)
 - [header list](#)
 - [body](#)
 - [internal response](#)
 - [location URL](#)
 - [timing info](#)
 - [service worker timing info](#)
- [request](#) and its associated:
 - [URL](#)
 - [method](#)
 - [header list](#)
 - [body](#)
 - [client](#)
 - [URL list](#)
 - [current URL](#)
 - [reserved client](#)
 - [replaces client id](#)
 - [initiator](#)
 - [destination](#)
 - [potential destination](#)
 - [translating a potential destination](#)
 - [script-like destinations](#)
 - [priority](#)
 - [origin](#)
 - [referrer](#)
 - [synchronous flag](#)
 - [mode](#)
 - [credentials mode](#)
 - [use-URL-credentials flag](#)
 - [unsafe-request flag](#)
 - [cache mode](#)
 - [redirect count](#)
 - [redirect mode](#)
 - [policy container](#)
 - [referrer policy](#)
 - [cryptographic nonce metadata](#)
 - [integrity metadata](#)
 - [parser metadata](#)
 - [reload-navigation flag](#)
 - [history-navigation flag](#)
 - [user-activation](#)

The following terms are defined in *Referrer Policy*: [\[REFERRERPOLICY\]](#)

- [*referrer policy*](#)
- The '[*Referrer-Policy*](#)' HTTP header
- The [*parse a referrer policy from a 'Referrer-Policy' header*](#) algorithm
- The "[*no-referrer*](#)", "[*no-referrer-when-downgrade*](#)", "[*origin-when-cross-origin*](#)", and "[*unsafe-url*](#)" referrer policies
- The [*default referrer policy*](#)

The following terms are defined in *Mixed Content*: [\[MIX\]](#)

- [*a priori authenticated URL*](#)

Paint Timing

The following terms are defined in *Paint Timing*: [\[PAINTTIMING\]](#)

- [*mark paint timing*](#)

Navigation Timing

The following terms are defined in *Navigation Timing*: [\[NAVIGATIONTIMING\]](#)

- [*create the navigation timing entry*](#)
- [*queue the navigation timing entry*](#)
- [*NavigationType*](#) and its "[*navigate*](#)", "[*reload*](#)", and "[*back_forward*](#)" values.

Long Tasks

The following terms are defined in *Long Tasks*: [\[LONGTASKS\]](#)

- [*report long tasks*](#)

Web IDL

The IDL fragments in this specification must be interpreted as required for conforming IDL fragments, as described in *Web IDL*. [\[WEBIDL\]](#)

The following terms are defined in *Web IDL*:

- [*this*](#)
- [*extended attribute*](#)
- [*named constructor*](#)
- [*constructor operation*](#)
- [*overridden constructor steps*](#)
- [*internally create a new object implementing the interface*](#)
- [*array index property name*](#)
- [*supports indexed properties*](#)

- [supported property indices](#)
- [determine the value of an indexed property](#)
- [set the value of an existing indexed property](#)
- [set the value of a new indexed property](#)
- [support named properties](#)
- [supported property names](#)
- [determine the value of a named property](#)
- [set the value of an existing named property](#)
- [set the value of a new named property](#)
- [delete an existing named property](#)
- [perform a security check](#)
- [platform object](#)
- [legacy platform object](#)
- [primary interface](#)
- [interface object](#)
- [include](#)
- [inherit](#)
- [interface prototype object](#)
- [\[\[Realm\]\] field of a platform object](#)
- [callback context](#)
- [frozen array](#) and [creating a frozen array](#)
- [create a new object implementing the interface](#)
- [callback this value](#)
- [converting](#) between Web IDL types and JS types
- [invoking](#) and [constructing](#) callback functions
- [overload resolution algorithm](#)
- [exposed](#)
- [a promise rejected with](#)
- [upon rejection](#)
- [\[LegacyFactoryFunction\]](#)
- [\[LegacyLenientThis\]](#)
- [\[LegacyNullToString\]](#)
- [\[LegacyOverrideBuiltIns\]](#)
- [\[LegacyTreatNonObjectAsNull\]](#)
- [\[LegacyUnenumerableNamedProperties\]](#)
- [\[LegacyUnforgeable\]](#)

Web IDL also defines the following types that are used in Web IDL fragments in this specification:

- [ArrayBuffer](#)
- [ArrayBufferView](#)
- [boolean](#)
- [DOMString](#)
- [double](#)
- [enumeration](#)
- [Function](#)

- [`long`](#)
- [`object`](#)
- [`Uint8ClampedArray`](#)
- [`unrestricted double`](#)
- [`unsigned long`](#)
- [`USVString`](#)
- [`VoidFunction`](#)

The term [`throw`](#) in this specification is used as defined in *Web IDL*. The [`DOMException`](#) type and the following exception names are defined by Web IDL and used by this specification:

- [`"IndexSizeError"`](#)
- [`"HierarchyRequestError"`](#)
- [`"InvalidCharacterError"`](#)
- [`"NoModificationAllowedError"`](#)
- [`"NotFoundError"`](#)
- [`"NotSupportedError"`](#)
- [`"InvalidStateError"`](#)
- [`"SyntaxError"`](#)
- [`"InvalidAccessError"`](#)
- [`"SecurityError"`](#)
- [`"NetworkError"`](#)
- [`"AbortError"`](#)
- [`"QuotaExceededError"`](#)
- [`"DataCloneError"`](#)
- [`"EncodingError"`](#)
- [`"NotAllowedError"`](#)

When this specification requires a user agent to *create a `Date` object* representing a particular time (which could be the special value Not-a-Number), the milliseconds component of that time, if any, must be truncated to an integer, and the time value of the newly created `Date` object must represent the resulting truncated time.

For instance, given the time 23045 millionths of a second after 01:00 UTC on January 1st 2000, i.e. the time 2000-01-01T00:00:00.023045Z, then the `Date` object created representing that time would represent the same time as that created representing the time 2000-01-01T00:00:00.023Z, 45 millionths earlier. If the given time is NaN, then the result is a `Date` object that represents a time value NaN (indicating that the object does not represent a specific instant of time).

JavaScript

Some parts of the language described by this specification only support JavaScript as the underlying scripting language. [\[JAVASCRIPT\]](#)

The term "JavaScript" is used to refer to ECMA-262, rather than the official term ECMAScript, since the term JavaScript is more widely known. Similarly, the [MIME type](#) used to refer to JavaScript in this specification is `text/javascript`, since that is the most commonly used type, [despite it being an officially obsoleted type](#) according to RFC 4329. [\[RFC4329\]](#)

The following terms are defined in the JavaScript specification and used in this specification:

- [*active function object*](#)
- [*agent*](#) and [*agent cluster*](#)
- [*automatic semicolon insertion*](#)
- [*candidate execution*](#)
- The [*current Realm Record*](#)
- [*early error*](#)
- [*forward progress*](#)
- [*invariants of the essential internal methods*](#)
- [*JavaScript execution context*](#)
- [*JavaScript execution context stack*](#)
- [*JavaScript realm*](#)
- [*JobCallback Record*](#)
- [*EnvironmentRecord*](#)
- [*NewTarget*](#)
- [*running JavaScript execution context*](#)
- [*surrounding agent*](#)
- [*abstract closure*](#)
- [*immutable prototype exotic object*](#)
- [*Well-Known Symbols*](#), including `@@hasInstance`, `@@isConcatSpreadable`, `@@toPrimitive`, and `@@toStringTag`
- [*Well-Known Intrinsic Objects*](#), including `%Array.prototype%`, `%Error.prototype%`, `%EvalError.prototype%`, `%Function.prototype%`, `%JSON.parse%`, `%Object.prototype%`, `%Object.prototype.valueOf%`, `%RangeError.prototype%`, `%ReferenceError.prototype%`, `%SyntaxError.prototype%`, `%TypeError.prototype%`, and `%URIError.prototype%`
- The [*FunctionBody*](#) production
- The [*Module*](#) production
- The [*Pattern*](#) production
- The [*Script*](#) production
- The [*Type*](#) notation
- The [*Completion Record*](#) specification type
- The [*List*](#) and [*Record*](#) specification types
- The [*Property Descriptor*](#) specification type
- The [*Script Record*](#) specification type
- The [*Cyclic Module Record*](#) specification type
- The [*Source Text Module Record*](#) specification type and its [*Evaluate*](#) and [*Link*](#) methods
- The [*ArrayCreate*](#) abstract operation

- The [Call](#) abstract operation
- The [ClearKeptObjects](#) abstract operation
- The [CleanupFinalizationRegistry](#) abstract operation
- The [Construct](#) abstract operation
- The [CopyDataBlockBytes](#) abstract operation
- The [CreateByteDataBlock](#) abstract operation
- The [CreateDataProperty](#) abstract operation
- The [DetachArrayBuffer](#) abstract operation
- The [EnumerableOwnPropertyNames](#) abstract operation
- The [FinishDynamicImport](#) abstract operation
- The [OrdinaryFunctionCreate](#) abstract operation
- The [Get](#) abstract operation
- The [GetActiveScriptOrModule](#) abstract operation
- The [GetFunctionRealm](#) abstract operation
- The [HasOwnProperty](#) abstract operation
- The [HostCallJobCallback](#) abstract operation
- The [HostEnqueueFinalizationRegistryCleanupJob](#) abstract operation
- The [HostEnqueuePromiseJob](#) abstract operation
- The [HostEnsureCanCompileStrings](#) abstract operation
- The [HostImportModuleDynamically](#) abstract operation
- The [HostMakeJobCallback](#) abstract operation
- The [HostPromiseRejectionTracker](#) abstract operation
- The [HostResolveImportedModule](#) abstract operation
- The [InitializeHostDefinedRealm](#) abstract operation
- The [IsAccessorDescriptor](#) abstract operation
- The [IsCallable](#) abstract operation
- The [IsConstructor](#) abstract operation
- The [IsDataDescriptor](#) abstract operation
- The [IsDetachedBuffer](#) abstract operation
- The [IsSharedArrayBuffer](#) abstract operation
- The [NewObjectEnvironment](#) abstract operation
- The [NormalCompletion](#) abstract operation
- The [OrdinaryGetPrototypeOf](#) abstract operation
- The [OrdinarySetPrototypeOf](#) abstract operation
- The [OrdinaryIsExtensible](#) abstract operation
- The [OrdinaryPreventExtensions](#) abstract operation
- The [OrdinaryGetOwnProperty](#) abstract operation
- The [OrdinaryDefineOwnProperty](#) abstract operation
- The [OrdinaryGet](#) abstract operation
- The [OrdinarySet](#) abstract operation
- The [OrdinaryDelete](#) abstract operation
- The [OrdinaryOwnPropertyKeys](#) abstract operation
- The [ObjectCreate](#) abstract operation
- The [ParseModule](#) abstract operation
- The [ParseScript](#) abstract operation
- The [NewPromiseReactionJob](#) abstract operation
- The [NewPromiseResolveThenableJob](#) abstract operation

- The [*RegExpBuiltinExec*](#) abstract operation
- The [*RegExpCreate*](#) abstract operation
- The [*RunJobs*](#) abstract operation
- The [*SameValue*](#) abstract operation
- The [*ScriptEvaluation*](#) abstract operation
- The [*SetImmutablePrototype*](#) abstract operation
- The [*ToBoolean*](#) abstract operation
- The [*ToString*](#) abstract operation
- The [*ToInt32*](#) abstract operation
- The [*TypedArrayCreate*](#) abstract operation
- The [*Abstract Equality Comparison*](#) algorithm
- The [*Strict Equality Comparison*](#) algorithm
- The [*Atomics*](#) object
- The [*Date*](#) class
- The [*FinalizationRegistry*](#) class
- The [*RegExp*](#) class
- The [*SharedArrayBuffer*](#) class
- The [*TypeError*](#) class
- The [*RangeError*](#) class
- The [*WeakRef*](#) class
- The [*eval\(\)*](#) function
- The [*WeakRef.prototype.deref\(\)*](#) function
- The [*\[\[IsHTMLDDA\]\]*](#) internal slot
- [*import\(\)*](#)
- [*import.meta*](#)
- The [*HostGetImportMetaProperties*](#) abstract operation
- The [*typeof*](#) operator
- The [*delete*](#) operator
- [*The TypedArray Constructors*](#) table

Users agents that support JavaScript must also implement *ECMAScript Internationalization API*. [\[JSINTL\]](#)

User agents that support JavaScript must also implement the *Import Assertions* proposal. The following terms are defined there, and used in this specification:
[\[JSIMPORTASSERTIONS\]](#)

- The [*ModuleRequest Record*](#) specification type
- The [*HostGetSupportedImportAssertions*](#) abstract operation

User agents that support JavaScript must also implement the *JSON modules* proposal. The following terms are defined there, and used in this specification: [\[JSJSONMODULES\]](#)

- The [*CreateDefaultExportSyntheticModule*](#) abstract operation
- The [*SetSyntheticModuleExport*](#) abstract operation
- The [*Synthetic Module Record*](#) specification type
- The [*ParseJSONModule*](#) abstract operation

WebAssembly

The following term is defined in *WebAssembly JavaScript Interface*: [\[WASMJS\]](#)

- [WebAssembly.Module](#)

DOM

The Document Object Model (DOM) is a representation — a model — of a document and its content. The DOM is not just an API; the conformance criteria of HTML implementations are defined, in this specification, in terms of operations on the DOM. [\[DOM\]](#)

Implementations must support DOM and the events defined in UI Events, because this specification is defined in terms of the DOM, and some of the features are defined as extensions to the DOM interfaces. [\[DOM\]](#) [\[UIEVENTS\]](#)

In particular, the following features are defined in *DOM*: [\[DOM\]](#)

- [Attr](#) interface
- [Comment](#) interface
- [DOMImplementation](#) interface
- [Document](#) interface
- [DocumentOrShadowRoot](#) interface
- [DocumentFragment](#) interface
- [DocumentType](#) interface
- [ChildNode](#) interface
- [Element](#) interface
- [attachShadow\(\)](#) method.
- An element's [shadow root](#)
- The [retargeting algorithm](#)
- [Node](#) interface
- [NodeList](#) interface
- [ProcessingInstruction](#) interface
- [ShadowRoot](#) interface
- [Text](#) interface
- [node document](#) concept
- [document type](#) concept
- [host](#) concept
- The [shadow root](#) concept, and its [delegates focus](#) and [available to element internals](#).
- The [shadow host](#) concept
- [HTMLCollection](#) interface, its [length](#) attribute, and its [item\(\)](#) and [namedItem\(\)](#) methods
- The terms [collection](#) and [represented by the collection](#)
- [DOMTokenList](#) interface, and its [value](#) attribute and [supports](#) operation
- [createDocument\(\)](#) method
- [createHTMLDocument\(\)](#) method
- [createElement\(\)](#) method

- `createElementNS()` method
- `getElementById()` method
- `getElementsByClassName()` method
- `appendChild()` method
- `cloneNode()` method
- `importNode()` method
- `preventDefault()` method
- `id` attribute
- `setAttribute()` method
- `textContent` attribute
- The `tree`, `shadow tree`, and `node tree` concepts
- The `tree order` and `shadow-including tree order` concepts
- The `child` concept
- The `root` and `shadow-including root` concepts
- The `inclusive ancestor`, `descendant`, `shadow-including descendant`, `shadow-including inclusive descendant`, and `shadow-including inclusive ancestor` concepts
- The `first child`, `next sibling`, and `previous sibling` concepts
- The `document element` concept
- The `in a document tree`, `in a document` (legacy), and `connected` concepts
- The `slot` concept, and its `name` and `assigned nodes`
- The `assigned slot` concept
- The `slot assignment` concept
- The `slottable` concept
- The `assign slottables for a tree` algorithm
- The `inclusive descendants` concept
- The `find flattened slottables` algorithm
- The `manual slot assignment` concept
- The `assign a slot` algorithm
- The `pre-insert`, `insert`, `append`, `replace`, `replace all`, `string replace all`, `remove`, and `adopt` algorithms for nodes
- The `descendant` concept
- The `insertion steps`, `removing steps`, `adopting steps`, and `children changed steps` hooks for elements
- The `change`, `append`, `remove`, `replace`, and `set value` algorithms for attributes
- The `attribute change steps` hook for attributes
- The `attribute list` concept
- The `data` of a text node and its `replace data` algorithm
- The `child text content` of a node
- The `descendant text content` of a node
- `Event` interface
- `Event and derived interfaces constructor behavior`
- `EventTarget` interface
- The `activation behavior` hook
- The `legacy-pre-activation behavior` hook
- The `legacy-canceled-activation behavior` hook
- The `create an event` algorithm

- The [fire an event](#) algorithm
- The [canceled flag](#)
- The [dispatch](#) algorithm
- [*EventInit*](#) dictionary type
- [type](#) attribute
- An event's [target](#)
- [currentTarget](#) attribute
- [bubbles](#) attribute
- [cancelable](#) attribute
- [composed](#) attribute
- [composed flag](#)
- [isTrusted](#) attribute
- [initEvent\(\)](#) method
- [add an event listener](#)
- [addEventListener\(\)](#) method
- The [remove an event listener](#) and [remove all event listeners](#) algorithms
- [*EventListener*](#) callback interface
- The [type](#) of an event
- An [event listener](#) and its [type](#) and [callback](#)
- The [encoding](#) (herein the *character encoding*), [mode](#), and [content type](#) of a [Document](#)
- The distinction between [XML documents](#) and [HTML documents](#)
- The terms [quirks mode](#), [limited-quirks mode](#), and [no-quirks mode](#)
- The algorithm to [clone](#) a [Node](#), and the concept of [cloning steps](#) used by that algorithm
- The concept of *base URL change steps* and the definition of what happens when an element is *affected by a base URL change*
- The concept of an element's [unique identifier \(ID\)](#)
- The concept of an element's [classes](#)
- The term [supported tokens](#)
- The concept of a DOM [range](#), and the terms [start](#), [end](#), and [boundary point](#) as applied to ranges.
- The [create an element](#) algorithm
- The [*element interface*](#) concept
- The concepts of [custom element state](#), and of [defined](#) and [custom](#) elements
- An element's [namespace](#), [namespace prefix](#), [local name](#), [custom element definition](#), and [is value](#)
- [*MutationObserver*](#) interface and [mutation observers](#) in general

The following features are defined in *UI Events*: [\[UIEVENTS\]](#)

- The [*MouseEvent*](#) interface
- The [*MouseEvent*](#) interface's [relatedTarget](#) attribute
- [*MouseEventInit*](#) dictionary type
- The [*FocusEvent*](#) interface
- The [*FocusEvent*](#) interface's [relatedTarget](#) attribute

- The [UIEvent](#) interface
- The [UIEvent](#) interface's [view](#) attribute
- [auxclick](#) event
- [click](#) event
- [dblclick](#) event
- [mousedown](#) event
- [mouseenter](#) event
- [mouseleave](#) event
- [mousemove](#) event
- [mouseout](#) event
- [mouseover](#) event
- [mouseup](#) event
- [wheel](#) event
- [keydown](#) event
- [keypress](#) event
- [keyup](#) event

The following features are defined in *Touch Events*: [\[TOUCH\]](#)

- [Touch](#) interface
- [Touch point](#) concept
- [touchend](#) event

The following features are defined in *Pointer Events*: [\[POINTEREVENTS\]](#)

- The [PointerEvent](#) interface
- The [PointerEvent](#) interface's [pointerType](#) attribute
- [fire a pointer event](#)
- [pointerdown](#) event
- [pointerup](#) event
- [pointercancel](#) event

This specification sometimes uses the term *name* to refer to the event's [type](#); as in, "an event named `click`" or "if the event name is `keypress`". The terms "*name*" and "*type*" for events are synonymous.

The following features are defined in *DOM Parsing and Serialization*: [\[DOMPARSING\]](#)

- [innerHTML](#)
- [outerHTML](#)

The following features are defined in *Selection API*: [\[SELECTION\]](#)

- [selection](#)
- [Selection](#)

User agents are encouraged to implement the features described in *execCommand*.
[[EXECCOMMAND](#)]

The following parts of *Fullscreen API* are referenced from this specification, in part to define the rendering of [dialog](#) elements, and also to define how the Fullscreen API interacts with HTML: [[FULLSCREEN](#)]

- [top layer](#) (an [ordered set](#)) and its [add](#) operation
- [requestFullscreen\(\)](#)
- [run the fullscreen steps](#)

High Resolution Time provides the [current high resolution time](#) and the [DOMHighResTimeStamp](#) typedef. [[HRT](#)]

File API

This specification uses the following features defined in *File API*: [[FILEAPI](#)]

- The [Blob](#) interface and its [type](#) attribute
- The [File](#) interface and its [name](#) and [lastModified](#) attributes
- The [FileList](#) interface
- The concept of a [Blob](#)'s [snapshot state](#)
- The concept of *read errors*
- [Blob URL Store](#)
- [blob URL entry](#) and its [object](#) and [environment](#)

Indexed Database API

This specification uses [cleanup Indexed Database transactions](#) defined by *Indexed Database API*. [[INDEXEDDB](#)]

Media Source Extensions

The following terms are defined in *Media Source Extensions*: [[MEDIASOURCE](#)]

- [MediaSource](#) interface
- [detaching from a media element](#)

Media Capture and Streams

The following terms are defined in *Media Capture and Streams*: [[MEDIASTREAM](#)]

- [MediaStream](#) interface

Reporting

The following terms are defined in *Reporting*: [[REPORTING](#)]

- [Queue a report](#)
- [report type](#)
- [visible to ReportingObservers](#)

XMLHttpRequest

The following features and terms are defined in *XMLHttpRequest*: [\[XHR\]](#)

- The [XMLHttpRequest](#) interface, and its [responseXML](#) attribute
- The [ProgressEvent](#) interface, and its [lengthComputable](#), [loaded](#), and [total](#) attributes
- The [FormData](#) interface
- The [FormDataEntryValue](#) type
- [entry](#)
- [create an entry](#)

Battery Status

The following features are defined in *Battery Status API*: [\[BATTERY\]](#)

- [getBattery\(\)](#) method

Media Queries

Implementations must support *Media Queries*. The [`<media-condition>`](#) feature is defined therein. [\[MQ\]](#)

CSS modules

While support for CSS as a whole is not required of implementations of this specification (though it is encouraged, at least for web browsers), some features are defined in terms of specific CSS requirements.

When this specification requires that something be [parsed according to a particular CSS grammar](#), the relevant algorithm in *CSS Syntax* must be followed, including error handling rules. [\[CSSSYNTAX\]](#)

For example, user agents are required to close all open constructs upon finding the end of a style sheet unexpectedly. Thus, when parsing the string "`rgb(0,0,0`" (with a missing close-parenthesis) for a color value, the close parenthesis is implied by this error handling rule, and a value is obtained (the color 'black'). However, the similar construct "`rgb(0,0,`" (with both a missing parenthesis and a missing "blue" value) cannot be parsed, as closing the open construct does not result in a viable value.

To parse a CSS `<color>` value, given a string *input* with an optional element *element*, run these steps:

1. Let *color* be the result of [parsing](#) *input* as a CSS `<color>`. [\[CSSCOLOR\]](#)

2. If *color* is failure, then return failure.
3. If *color* is '[currentcolor](#)', then:
 1. If *element* is not given, then set *color* to [opaque black](#).
 2. Otherwise, set *color* to the computed value of the '[color](#)' property of *element*.
4. Return *color*.

The following terms and features are defined in *Cascading Style Sheets (CSS)*: [\[CSS\]](#)

- [viewport](#)
- [line box](#)
- [out-of-flow](#)
- [in-flow](#)
- [collapsing margins](#)
- [containing block](#)
- [inline box](#)
- [block box](#)
- The '[top](#)', '[bottom](#)', '[left](#)', and '[right](#)' properties
- The '[float](#)' property
- The '[clear](#)' property
- The '[width](#)' property
- The '[height](#)' property
- The '[max-width](#)' property
- The '[max-height](#)' property
- The '[line-height](#)' property
- The '[vertical-align](#)' property
- The '[content](#)' property
- The '[inline-block](#)' value of the '[display](#)' property
- The '[visibility](#)' property

The basic version of the '[display](#)' property is defined in CSS, and the property is extended by other CSS modules. [\[CSS\]](#) [\[CSSRUBY\]](#) [\[CSSTABLE\]](#)

The following terms and features are defined in *CSS Box Model*: [\[CSSBOX\]](#)

- [content area](#)
- [content box](#)
- [border box](#)
- [margin box](#)
- [border edge](#)
- [margin edge](#)
- The '[margin-top](#)', '[margin-bottom](#)', '[margin-left](#)', and '[margin-right](#)' properties
- The '[padding-top](#)', '[padding-bottom](#)', '[padding-left](#)', and '[padding-right](#)' properties

The following features are defined in *CSS Logical Properties*: [\[CSSLOGICAL\]](#)

- The '[*margin-block-start*](#)', '[*margin-block-end*](#)', '[*margin-inline-start*](#)', and '[*margin-inline-end*](#)' properties
- The '[*padding-block-start*](#)', '[*padding-block-end*](#)', '[*padding-inline-start*](#)', and '[*padding-inline-end*](#)' properties
- The '[*border-block-start-width*](#)' property
- The '[*block-size*](#)' property
- The '[*inline-size*](#)' property
- The '[*inset-block-start*](#)' property
- The '[*inset-block-end*](#)' property

The following terms and features are defined in *CSS Color*: [\[CSSCOLOR\]](#)

- [*named color*](#)
- [*<color>*](#)
- The '[*color*](#)' property
- The '[*currentcolor*](#)' value
- [*opaque black*](#)
- [*transparent black*](#)
- [*srgb*](#) color space
- [*display-p3*](#) color space
- [*relative-colorimetric*](#) rendering intent

The following terms are defined in *CSS Images*: [\[CSSIMAGES\]](#)

- [*default object size*](#)
- [*intrinsic dimensions*](#)
- [*intrinsic height*](#)
- [*intrinsic width*](#)
- The '[*image-orientation*](#)' property
- [*conic-gradient*](#)
- The '[*object-fit*](#)' property

The term [*paint source*](#) is used as defined in *CSS Images Level 4* to define the interaction of certain HTML elements with the CSS 'element()' function. [\[CSSIMAGES4\]](#)

The following features are defined in *CSS Backgrounds and Borders*: [\[CSSBG\]](#)

- The '[*background-color*](#)' property
- The '[*background-image*](#)' property
- The '[*border-radius*](#)' property

CSS Backgrounds and Borders also defines the following border properties: [\[CSSBG\]](#)

Border properties			
Top	Bottom	Left	Right

Width	<code>'border-top-width'</code>	<code>'border-bottom-width'</code>	<code>'border-left-width'</code>	<code>'border-right-width'</code>
Style	<code>'border-top-style'</code>	<code>'border-bottom-style'</code>	<code>'border-left-style'</code>	<code>'border-right-style'</code>
Color	<code>'border-top-color'</code>	<code>'border-bottom-color'</code>	<code>'border-left-color'</code>	<code>'border-right-color'</code>

The following features are defined in *CSS Box Alignment*: [\[CSSALIGN\]](#)

- The [`'align-content'`](#) property
- The [`'align-items'`](#) property
- The [`'align-self'`](#) property
- The [`'justify-self'`](#) property
- The [`'justify-content'`](#) property
- The [`'justify-items'`](#) property

The following terms and features are defined in *CSS Display*: [\[CSSDISPLAY\]](#)

- [`outer display type`](#)
- [`inner display type`](#)
- [`block-level`](#)
- [`block container`](#)
- [`formatting context`](#)
- [`block formatting context`](#)
- [`inline formatting context`](#)
- [`replaced element`](#)
- [`CSS box`](#)

The following features are defined in *CSS Flexible Box Layout*: [\[CSSFLEXBOX\]](#)

- The [`'flex-direction'`](#) property
- The [`'flex-wrap'`](#) property

The following terms and features are defined in *CSS Fonts*: [\[CSSFONTS\]](#)

- [`first available font`](#)
- The [`'font-family'`](#) property
- The [`'font-weight'`](#) property
- The [`'font-size'`](#) property
- The [`'font'`](#) property
- The [`'font-kerning'`](#) property
- The [`'font-stretch'`](#) property
- The [`'font-variant-caps'`](#) property
- The [`'small-caps'`](#) value
- The [`'all-small-caps'`](#) value
- The [`'petite-caps'`](#) value
- The [`'all-petite-caps'`](#) value
- The [`'unicase'`](#) value
- The [`'titling-caps'`](#) value
- The [`'ultra-condensed'`](#) value

- The '[extra-condensed](#)' value
- The '[condensed](#)' value
- The '[semi-condensed](#)' value
- The '[semi-expanded](#)' value
- The '[expanded](#)' value
- The '[extra-expanded](#)' value
- The '[ultra-expanded](#)' value

The following features are defined in *CSS Grid Layout*: [\[CSSGRID\]](#)

- The '[grid-auto-columns](#)' property
- The '[grid-auto-flow](#)' property
- The '[grid-auto-rows](#)' property
- The '[grid-column-gap](#)' property
- The '[grid-row-gap](#)' property
- The '[grid-template-areas](#)' property
- The '[grid-template-columns](#)' property
- The '[grid-template-rows](#)' property

The following terms are defined in *CSS Inline Layout*: [\[CSSINLINE\]](#)

- [alphabetic baseline](#)
- [ascent metric](#)
- [descent metric](#)
- [hanging baseline](#)
- [ideographic-under baseline](#)

The following terms and features are defined in *CSS Intrinsic & Extrinsic Sizing*: [\[CSSSIZING\]](#)

- [fit-content inline size](#)
- ['aspect-ratio'](#) property

The following features are defined in *CSS Lists and Counters*. [\[CSSLISTS\]](#)

- [list item](#)
- The '[counter-reset](#)' property
- The '[counter-set](#)' property
- The '[list-style-type](#)' property

The following features are defined in *CSS Overflow*. [\[CSCOVERFLOW\]](#)

- The '[overflow](#)' property and its '[hidden](#)' value
- The '[text-overflow](#)' property
- The term [scroll container](#)

The following terms and features are defined in *CSS Positioned Layout*: [\[CSSPOSITION\]](#)

- [absolutely-positioned](#)
- The ['position'](#) property and its ['static'](#) value

The following features are defined in *CSS Multi-column Layout*. [\[CSSMULTICOL\]](#)

- The ['column-count'](#) property
- The ['column-fill'](#) property
- The ['column-gap'](#) property
- The ['column-rule'](#) property
- The ['column-width'](#) property

The ['ruby-base'](#) value of the ['display'](#) property is defined in *CSS Ruby Layout*. [\[CSSRUBY\]](#)

The following features are defined in *CSS Table*: [\[CSSTABLE\]](#)

- The ['border-spacing'](#) property
- The ['border-collapse'](#) property
- The ['table-cell'](#), ['table-row'](#), ['table-caption'](#), and ['table'](#) values of the ['display'](#) property

The following features are defined in *CSS Text*: [\[CSSTEXT\]](#)

- The ['text-transform'](#) property
- The ['white-space'](#) property
- The ['text-align'](#) property
- The ['letter-spacing'](#) property
- The ['word-spacing'](#) property

The following features are defined in *CSS Writing Modes*: [\[CSSWM\]](#)

- The ['direction'](#) property
- The ['unicode-bidi'](#) property
- The [block flow direction](#), [block axis](#), [inline axis](#), [block size](#), [inline size](#), [block-start](#), [block-end](#), [inline-start](#), [inline-end](#), [line-left](#), and [line-right](#) concepts

The following features are defined in *CSS Basic User Interface*: [\[CSSUI\]](#)

- The ['outline'](#) property
- The ['cursor'](#) property
- The ['appearance'](#) property

The algorithm to [update animations and send events](#) is defined in *Web Animations*. [\[WEBANIMATIONS\]](#).

Implementations that support scripting must support the CSS Object Model. The following features and terms are defined in the CSSOM specifications: [\[CSSOM\]](#) [\[CSSOMVIEW\]](#)

- [Screen](#) interface

- [*LinkStyle*](#) interface
- [*CSSStyleDeclaration*](#) interface
- [*style*](#) IDL attribute
- [*cssText*](#) attribute of [*CSSStyleDeclaration*](#)
- [*StyleSheet*](#) interface
- [*CSSStyleSheet*](#) interface
- [*create a CSS style sheet*](#)
- [*remove a CSS style sheet*](#)
- [*associated CSS style sheet*](#)
- [*create a constructed CSSStyleSheet*](#)
- [*synchronously replace the rules of a CSSStyleSheet*](#)
- [*CSS style sheets*](#) and their properties:
 - [*type*](#)
 - [*location*](#)
 - [*parent CSS style sheet*](#)
 - [*owner node*](#)
 - [*owner CSS rule*](#)
 - [*media*](#)
 - [*title*](#)
 - [*alternate flag*](#)
 - [*disabled flag*](#)
 - [*CSS rules*](#)
 - [*origin-clean flag*](#)
- [*CSS style sheet set*](#)
- [*CSS style sheet set name*](#)
- [*preferred CSS style sheet set name*](#)
- [*change the preferred CSS style sheet set name*](#)
- [*Serializing a CSS value*](#)
- [*run the resize steps*](#)
- [*run the scroll steps*](#)
- [*evaluate media queries and report changes*](#)
- [*Scroll an element into view*](#)
- [*Scroll to the beginning of the document*](#)
- The [*resize*](#) event
- The [*scroll*](#) event
- [*set up browsing context features*](#)

The following features and terms are defined in *CSS Syntax*: [\[CSSSYNTAX\]](#)

- [*conformant style sheet*](#)
- [*parse a list of component values*](#)
- [*parse a comma-separated list of component values*](#)
- [*component value*](#)
- [*environment encoding*](#)
- [*<whitespace-token>*](#)

The following terms are defined in *Selectors*: [\[SELECTORS\]](#)

- [type selector](#)
- [attribute selector](#)
- [pseudo-class](#)
- [:focus-visible](#) pseudo-class

The following features are defined in *CSS Values and Units*: [\[CSSVALUES\]](#)

- [<length>](#)
- The ['em'](#) unit
- The ['ex'](#) unit
- The ['vw'](#) unit
- The ['in'](#) unit
- The ['px'](#) unit
- The ['pt'](#) unit
- The ['attr\(\)' function](#)
- The [math functions](#)

The term [style attribute](#) is defined in *CSS Style Attributes*. [\[CSSATTR\]](#)

The following terms are defined in the *CSS Cascading and Inheritance*: [\[CSSCASCADE\]](#)

- [specified value](#)
- [computed value](#)
- [used value](#)

The [CanvasRenderingContext2D](#) object's use of fonts depends on the features described in the *CSS Fonts* and *Font Loading* specifications, including in particular [FontFace](#) objects and the [font source](#) concept. [\[CSSFONTS\]](#) [\[CSSFONTLOAD\]](#)

The following interfaces and terms are defined in *Geometry Interfaces*: [\[GEOMETRY\]](#)

- [DOMMatrix](#) interface, and associated [m11 element](#), [m12 element](#), [m21 element](#), [m22 element](#), [m41 element](#), and [m42 element](#)
- [DOMMatrix2DInit](#) and [DOMMatrixInit](#) dictionaries
- The [create a DOMMatrix from a dictionary](#) and [create a DOMMatrix from a 2D dictionary](#) algorithms for [DOMMatrix2DInit](#) or [DOMMatrixInit](#)
- The [DOMPointInit](#) dictionary, and associated x and y members

The following terms are defined in the *CSS Scoping*: [\[CSSSCOPING\]](#)

- [flat tree](#)

The following terms and features are defined in *CSS Color Adjustment*: [\[CSSCOLORADJUST\]](#)

- ['color-scheme'](#)
- [page's supported color-schemes](#)

The following term is defined in *CSS Pseudo-Elements*: [\[CSSPSEUDO\]](#)

- [*::file-selector-button*](#)

The following term is defined in *CSS Containment*: [\[CSSCONTAIN\]](#)

- [*skips its contents*](#)

Intersection Observer

The following term is defined in *Intersection Observer*: [\[INTERSECTIONOBSERVER\]](#)

- [*run the update intersection observations steps*](#)
- [*IntersectionObserver*](#)
- [*IntersectionObserverInit*](#)
- [*observe*](#)
- [*unobserve*](#)
- [*isIntersecting*](#)
- [*target*](#)

WebGL

The following interfaces are defined in the WebGL specifications: [\[WEBGL\]](#)

- [*WebGLRenderingContext*](#) interface
- [*WebGL2RenderingContext*](#) interface
- [*WebGLContextAttributes*](#) dictionary

WebGPU

The following interfaces are defined in *WebGPU*: [\[WEBGPU\]](#)

- [*GPUCanvasContext*](#) interface

WebVTT

Implementations may support WebVTT as a text track format for subtitles, captions, metadata, etc., for media resources. [\[WEBVTT\]](#)

The following terms, used in this specification, are defined in *WebVTT*:

- [*WebVTT file*](#)
- [*WebVTT file using cue text*](#)
- [*WebVTT file using only nested cues*](#)
- [*WebVTT parser*](#)
- The [*rules for updating the display of WebVTT text tracks*](#)
- The WebVTT [*text track cue writing direction*](#)
- [*VTCue*](#) interface

The WebSocket protocol

The following terms are defined in *Fetch*: [\[FETCH\]](#)

- [establish a WebSocket connection](#)

The following terms are defined in *The WebSocket protocol*: [\[WSP\]](#)

- *the WebSocket connection is established*
- *extensions in use*
- *subprotocol in use*
- *a WebSocket message has been received*
- *send a WebSocket Message*
- *fail the WebSocket connection*
- *close the WebSocket connection*
- *start the WebSocket closing handshake*
- *the WebSocket closing handshake is started*
- *the WebSocket connection is closed (possibly cleanly)*
- *the WebSocket connection close code*
- *the WebSocket connection close reason*
- *Sec-WebSocket-Protocol field*

ARIA

The *role* attribute is defined in *Accessible Rich Internet Applications (ARIA)*, as are the following roles: [\[ARIA\]](#)

- [button](#)
- [presentation](#)

In addition, the following *aria-** content attributes are defined in *ARIA*: [\[ARIA\]](#)

- [aria-checked](#)
- [aria-describedby](#)
- [aria-disabled](#)
- [aria-label](#)

Finally, the following terms are defined *ARIA*: [\[ARIA\]](#)

- [role](#)
- [accessible name](#)
- The [ARIAMixin](#) interface, with its associated [ARIAMixin getter steps](#) and [ARIAMixin setter steps](#) hooks

Content Security Policy

The following terms are defined in *Content Security Policy*: [\[CSP\]](#)

- [*Content Security Policy*](#)
- [*disposition*](#)
- [*directive set*](#)
- [*Content Security Policy directive*](#)
- [*CSP list*](#)
- The [*Content Security Policy syntax*](#)
- [*enforce the policy*](#)
- The [*parse a serialized Content Security Policy*](#) algorithm
- The [*Run CSP initialization for a Document*](#) algorithm
- The [*Run CSP initialization for a global object*](#) algorithm
- The [*Should element's inline behavior be blocked by Content Security Policy?*](#) algorithm
- The [*Should navigation request of type be blocked by Content Security Policy?*](#) algorithm
- The [*Should navigation response to navigation request of type in target be blocked by Content Security Policy?*](#) algorithm
- The [*report-uri directive*](#)
- The [*EnsureCSPDoesNotBlockStringCompilation*](#) abstract operation
- The [*Is base allowed for Document?*](#) algorithm
- The [*frame-ancestors directive*](#)
- The [*sandbox directive*](#)
- The [*contains a header-delivered Content Security Policy*](#) property.
- The [*Parse a response's Content Security Policies*](#) algorithm.

Service Workers

The following terms are defined in *Service Workers*: [\[SW\]](#)

- [*active worker*](#)
- [*client message queue*](#)
- [*control*](#)
- [*handle fetch*](#)
- [*match service worker registration*](#)
- [*service worker*](#)
- [*service worker client*](#)
- [*ServiceWorker* interface](#)
- [*ServiceWorkerContainer* interface](#)
- [*ServiceWorkerGlobalScope* interface](#)

Secure Contexts

The following algorithms are defined in *Secure Contexts*: [\[SECURE-CONTEXTS\]](#)

- [*Is url potentially trustworthy?*](#)

Permissions Policy

The following terms are defined in *Permissions Policy*: [\[PERMISSIONSPOLICY\]](#)

- [*permissions policy*](#)
- [*policy-controlled feature*](#)
- [*container policy*](#)
- [*serialized permissions policy*](#)
- [*default allowlist*](#)
- The [*creating a permissions policy*](#) algorithm
- The [*creating a permissions policy from a response*](#) algorithm
- The [*is feature enabled by policy for origin*](#) algorithm
- The [*process permissions policy attributes*](#) algorithm

Payment Request API

The following feature is defined in *Payment Request API*: [\[PAYMENTREQUEST\]](#)

- [*PaymentRequest*](#) interface

MathML

While support for MathML as a whole is not required by this specification (though it is encouraged, at least for web browsers), certain features depend upon small parts of MathML being implemented. [\[MATHML\]](#)

The following features are defined in *Mathematical Markup Language (MathML)*:

- [*MathML annotation-xml*](#) element
- [*MathML math*](#) element
- [*MathML merror*](#) element
- [*MathML mi*](#) element
- [*MathML mn*](#) element
- [*MathML mo*](#) element
- [*MathML ms*](#) element
- [*MathML mtext*](#) element

SVG

While support for SVG as a whole is not required by this specification (though it is encouraged, at least for web browsers), certain features depend upon parts of SVG being implemented.

User agents that implement SVG must implement the *SVG 2* specification, and not any earlier revisions.

The following features are defined in the *SVG 2* specification: [\[SVG\]](#)

- [*SVGElement*](#) interface
- [*SVGImageElement*](#) interface
- [*SVGScriptElement*](#) interface
- [*SVGSVGElement*](#) interface

- [SVG `a` element](#)
- [SVG `desc` element](#)
- [SVG `foreignObject` element](#)
- [SVG `image` element](#)
- [SVG `script` element](#)
- [SVG `svg` element](#)
- [SVG `title` element](#)
- [SVG `use` element](#)
- [SVG `text-rendering` property](#)

Filter Effects

The following feature is defined in *Filter Effects*: [\[FILTERS\]](#)

- [`<filter-value-list>`](#)

Cooperative Scheduling of Background Tasks

The following features are defined in *Cooperative Scheduling of Background Tasks*: [\[REQUESTIDLECALLBACK\]](#)

- [`requestIdleCallback\(\)`](#)
- [start an idle period algorithm](#)

Storage

The following terms are defined in *Storage*: [\[STORAGE\]](#)

- [obtain a local storage bottle map](#)
- [obtain a session storage bottle map](#)
- [storage proxy map](#)
- [legacy-clone a browsing session storage shed](#)

Web App Manifest

The following features are defined in *Web App Manifest*: [\[MANIFEST\]](#)

- [application manifest](#)
- [installed web application](#)
- [process the manifest](#)

WebCodecs

The following features are defined in *WebCodecs*: [\[WEBCODECS\]](#)

- [`VideoFrame` interface.](#)
- [`\[\[display width\]\]`](#)
- [`\[\[display height\]\]`](#)

WebDriver BiDi

The following terms are defined in *WebDriver BiDi*: [\[WEBDRIVERBIDI\]](#)

- [*WebDriver BiDi navigation status*](#)
- [*navigation status id*](#)
- [*navigation status status*](#)
- [*navigation status canceled*](#)
- [*navigation status pending*](#)
- [*navigation status complete*](#)
- [*navigation status url*](#)
- [*WebDriver BiDi navigation started*](#)
- [*WebDriver BiDi navigation aborted*](#)
- [*WebDriver BiDi navigation failed*](#)
- [*WebDriver BiDi download started*](#)
- [*WebDriver BiDi fragment navigated*](#)
- [*WebDriver BiDi DOM content loaded*](#)
- [*WebDriver BiDi load complete*](#)

UUID

The following terms are defined in *uuid*: [\[UUID\]](#)

- [*generating a random UUID*](#)
-

This specification does not *require* support of any particular network protocol, style sheet language, scripting language, or any of the DOM specifications beyond those required in the list above. However, the language described by this specification is biased towards CSS as the styling language, JavaScript as the scripting language, and HTTP as the network protocol, and several features assume that those languages and protocols are in use.

A user agent that implements the HTTP protocol must implement *HTTP State Management Mechanism* (Cookies) as well. [\[HTTP\]](#) [\[COOKIES\]](#)

This specification might have certain additional requirements on character encodings, image formats, audio formats, and video formats in the respective sections.

2.1.10 Extensibility

Vendor-specific proprietary user agent extensions to this specification are strongly discouraged. Documents must not use such extensions, as doing so reduces interoperability and fragments the user base, allowing only users of specific user agents to access the content in question.

All extensions must be defined so that the use of extensions neither contradicts nor causes the non-conformance of functionality defined in the specification.

For example, while strongly discouraged from doing so, an implementation could add a new

IDL attribute "`typeTime`" to a control that returned the time it took the user to select the current value of a control (say). On the other hand, defining a new control that appears in a form's `elements` array would be in violation of the above requirement, as it would violate the definition of `elements` given in this specification.

When vendor-neutral extensions to this specification are needed, either this specification can be updated accordingly, or an extension specification can be written that overrides the requirements in this specification. When someone applying this specification to their activities decides that they will recognize the requirements of such an extension specification, it becomes an *applicable specification* for the purposes of conformance requirements in this specification.

Someone could write a specification that defines any arbitrary byte stream as conforming, and then claim that their random junk is conforming. However, that does not mean that their random junk actually is conforming for everyone's purposes: if someone else decides that that specification does not apply to their work, then they can quite legitimately say that the aforementioned random junk is just that, junk, and not conforming at all. As far as conformance goes, what matters in a particular community is what that community *agrees* is applicable.

User agents must treat elements and attributes that they do not understand as semantically neutral; leaving them in the DOM (for DOM processors), and styling them according to CSS (for CSS processors), but not inferring any meaning from them.

When support for a feature is disabled (e.g. as an emergency measure to mitigate a security problem, or to aid in development, or for performance reasons), user agents must act as if they had no support for the feature whatsoever, and as if the feature was not mentioned in this specification. For example, if a particular feature is accessed via an attribute in a Web IDL interface, the attribute itself would be omitted from the objects that implement that interface — leaving the attribute on the object but making it return null or throw an exception is insufficient.

2.1.11 Interactions with XPath and XSLT

Implementations of XPath 1.0 that operate on `HTML documents` parsed or created in the manners described in this specification (e.g. as part of the `document.evaluate()` API) must act as if the following edit was applied to the XPath 1.0 specification.

First, remove this paragraph:

A `QName` in the node test is expanded into an `expanded-name` using the namespace declarations from the expression context. This is the same way expansion is done for element type names in start and end-tags except that the default namespace declared with `xmlns` is not used: if the `QName` does not have a prefix, then the namespace URI is null (this is the same way attribute names are expanded). It is an error if the `QName` has a prefix for which there is no namespace declaration in the expression context.

Then, insert in its place the following:

A QName in the node test is expanded into an expanded-name using the namespace declarations from the expression context. If the QName has a prefix, then there must be a namespace declaration for this prefix in the expression context, and the corresponding namespace URI is the one that is associated with this prefix. It is an error if the QName has a prefix for which there is no namespace declaration in the expression context.

If the QName has no prefix and the principal node type of the axis is element, then the default element namespace is used. Otherwise if the QName has no prefix, the namespace URI is null. The default element namespace is a member of the context for the XPath expression. The value of the default element namespace when executing an XPath expression through the DOM3 XPath API is determined in the following way:

1. If the context node is from an HTML DOM, the default element namespace is "http://www.w3.org/1999/xhtml".
2. Otherwise, the default element namespace URI is null.

This is equivalent to adding the default element namespace feature of XPath 2.0 to XPath 1.0, and using the HTML namespace as the default element namespace for HTML documents. It is motivated by the desire to have implementations be compatible with legacy HTML content while still supporting the changes that this specification introduces to HTML regarding the namespace used for HTML elements, and by the desire to use XPath 1.0 rather than XPath 2.0.

This change is a [willful violation](#) of the XPath 1.0 specification, motivated by desire to have implementations be compatible with legacy content while still supporting the changes that this specification introduces to HTML regarding which namespace is used for HTML elements.

[\[XPATH10\]](#)

XSLT 1.0 processors outputting to a DOM when the output method is "html" (either explicitly or via the defaulting rule in XSLT 1.0) are affected as follows:

If the transformation program outputs an element in no namespace, the processor must, prior to constructing the corresponding DOM element node, change the namespace of the element to the [HTML namespace](#), [ASCII-lowercase](#) the element's local name, and [ASCII-lowercase](#) the names of any non-namespaced attributes on the element.

This requirement is a [willful violation](#) of the XSLT 1.0 specification, required because this specification changes the namespaces and case-sensitivity rules of HTML in a manner that would otherwise be incompatible with DOM-based XSLT transformations. (Processors that serialize the output are unaffected.) [\[XSLT10\]](#)

This specification does not specify precisely how XSLT processing interacts with the [HTML](#)

[parser](#) infrastructure (for example, whether an XSLT processor acts as if it puts any elements into a [stack of open elements](#)). However, XSLT processors must [stop parsing](#) if they successfully complete, and must [update the current document readiness](#) first to "interactive" and then to "complete" if they are aborted.

This specification does not specify how XSLT interacts with the [navigation](#) algorithm, how it fits in with the [event loop](#), nor how error pages are to be handled (e.g. whether XSLT errors are to replace an incremental XSLT output, or are rendered inline, etc.).

There are also additional non-normative comments regarding the interaction of XSLT and HTML [in the script element section](#), and of XSLT, XPath, and HTML [in the template element section](#).

2.2 Policy-controlled features

This document defines the following [policy-controlled features](#):

MDN

[Headers/Feature-Policy/autoplay](#)

Firefox 65+ Safari No Chrome 64+

Opera 51+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 65+ Safari iOS No Chrome Android 64+ WebView Android 64+ Samsung Internet 9.0+ Opera Android 47+

[Headers/Feature-Policy/document-domain](#)

Firefox 65+ Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 65+ Safari iOS No Chrome Android No WebView Android No Samsung Internet No Opera Android No

- "*autoplay*", which has a [default allowlist](#) of '`self`'.
- "*cross-origin-isolated*", which has a [default allowlist](#) of '`self`'.
- "*document-domain*", which has a [default allowlist](#) of '*'.

2.3 Common microsyntaxes

There are various places in HTML that accept particular data types, such as dates or numbers. This section describes what the conformance criteria for content in those formats is, and how to parse them.

Implementers are strongly urged to carefully examine any third-party libraries they might consider using to implement the parsing of syntaxes described below. For example, date libraries are likely to implement error handling behavior that differs from what is required in this specification, since error-handling behavior is often not defined in specifications that describe date syntaxes similar to those used in this specification, and thus implementations tend to vary greatly in how they handle errors.

2.3.1 Common parser idioms

Some of the micro-parsers described below follow the pattern of having an *input* variable that holds the string being parsed, and having a *position* variable pointing at the next character to parse in *input*.

2.3.2 Boolean attributes

A number of attributes are *boolean attributes*. The presence of a boolean attribute on an element represents the true value, and the absence of the attribute represents the false value.

If the attribute is present, its value must either be the empty string or a value that is an [ASCII case-insensitive](#) match for the attribute's canonical name, with no leading or trailing whitespace.

The values "true" and "false" are not allowed on boolean attributes. To represent a false value, the attribute has to be omitted altogether.

Here is an example of a checkbox that is checked and disabled. The [`checked`](#) and [`disabled`](#) attributes are the boolean attributes.

```
<label><input type=checkbox checked name=cheese disabled> Cheese</label>
```

This could be equivalently written as this:

```
<label><input type=checkbox checked=checked name=cheese disabled=disabled> Ch
```

You can also mix styles; the following is still equivalent:

```
<label><input type='checkbox' checked name=cheese disabled=""> Cheese</label>
```

2.3.3 Keywords and enumerated attributes

Some attributes are defined as taking one of a finite set of keywords. Such attributes are called *enumerated attributes*. The keywords are each defined to map to a particular *state* (several keywords might map to the same state, in which case some of the keywords are synonyms of each other; additionally, some of the keywords can be said to be non-conforming, and are only in the specification for historical reasons). In addition, two default states can be given. The first is the *invalid value default*, the second is the *missing value default*.

If an enumerated attribute is specified, the attribute's value must be an [ASCII case-insensitive](#) match for one of the given keywords that are not said to be non-conforming, with no leading or trailing whitespace.

When the attribute is specified, if its value is an [ASCII case-insensitive](#) match for one of the given keywords then that keyword's state is the state that the attribute represents. If the attribute value matches none of the given keywords, but the attribute has an [invalid value default](#), then the attribute represents that state. Otherwise, there is no default, and invalid values mean that there is no state represented.

When the attribute is *not* specified, if there is a [missing value default](#) state defined, then that is the state represented by the (missing) attribute. Otherwise, the absence of the attribute means that there is no state represented.

The empty string can be a valid keyword.

2.3.4 Numbers

2.3.4.1 Signed integers

A string is a *valid integer* if it consists of one or more [ASCII digits](#), optionally prefixed with a U+002D HYPHEN-MINUS character (-).

A [valid integer](#) without a U+002D HYPHEN-MINUS (-) prefix represents the number that is represented in base ten by that string of digits. A [valid integer](#) with a U+002D HYPHEN-MINUS (-) prefix represents the number represented in base ten by the string of digits that follows the U+002D HYPHEN-MINUS, subtracted from zero.

The *rules for parsing integers* are as given in the following algorithm. When invoked, the steps must be followed in the order given, aborting at the first step that returns a value. This algorithm will return either an integer or an error.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Let *sign* have the value "positive".
4. [Skip ASCII whitespace](#) within *input* given *position*.
5. If *position* is past the end of *input*, return an error.
6. If the character indicated by *position* (the first character) is a U+002D HYPHEN-MINUS character (-):
 1. Let *sign* be "negative".
 2. Advance *position* to the next character.
 3. If *position* is past the end of *input*, return an error.

Otherwise, if the character indicated by *position* (the first character) is a U+002B PLUS SIGN character (+):

1. Advance *position* to the next character. (The "+" is ignored, but it is not conforming.)
2. If *position* is past the end of *input*, return an error.
7. If the character indicated by *position* is not an [ASCII digit](#), then return an error.
8. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, and interpret the resulting sequence as a base-ten integer. Let *value* be that integer.
9. If *sign* is "positive", return *value*, otherwise return the result of subtracting *value* from zero.

2.3.4.2 Non-negative integers

A string is a *valid non-negative integer* if it consists of one or more [ASCII digits](#).

A [valid non-negative integer](#) represents the number that is represented in base ten by that string of digits.

The *rules for parsing non-negative integers* are as given in the following algorithm. When invoked, the steps must be followed in the order given, aborting at the first step that returns a value. This algorithm will return either zero, a positive integer, or an error.

1. Let *input* be the string being parsed.
2. Let *value* be the result of parsing *input* using the [rules for parsing integers](#).
3. If *value* is an error, return an error.
4. If *value* is less than zero, return an error.
5. Return *value*.

2.3.4.3 Floating-point numbers

A string is a *valid floating-point number* if it consists of:

1. Optionally, a U+002D HYPHEN-MINUS character (-).
2. One or both of the following, in the given order:
 1. A series of one or more [ASCII digits](#).
 2. Both of the following, in the given order:
 1. A single U+002E FULL STOP character (.).
 2. A series of one or more [ASCII digits](#).
3. Optionally:
 1. Either a U+0065 LATIN SMALL LETTER E character (e) or a U+0045 LATIN

- CAPITAL LETTER E character (E).
- 2. Optionally, a U+002D HYPHEN-MINUS character (-) or U+002B PLUS SIGN character (+).
- 3. A series of one or more [ASCII digits](#).

A [valid floating-point number](#) represents the number obtained by multiplying the significand by ten raised to the power of the exponent, where the significand is the first number, interpreted as base ten (including the decimal point and the number after the decimal point, if any, and interpreting the significand as a negative number if the whole string starts with a U+002D HYPHEN-MINUS character (-) and the number is not zero), and where the exponent is the number after the E, if any (interpreted as a negative number if there is a U+002D HYPHEN-MINUS character (-) between the E and the number and the number is not zero, or else ignoring a U+002B PLUS SIGN character (+) between the E and the number if there is one). If there is no E, then the exponent is treated as zero.

The Infinity and Not-a-Number (NaN) values are not [valid floating-point numbers](#).

The [valid floating-point number](#) concept is typically only used to restrict what is allowed for authors, while the user agent requirements use the [rules for parsing floating-point number values](#) below (e.g., the [max](#) attribute of the [progress](#) element). However, in some cases the user agent requirements include checking if a string is a [valid floating-point number](#) (e.g., the [value sanitization algorithm](#) for the [Number](#) state of the [input](#) element, or the [parse a srcset attribute](#) algorithm).

The *best representation of the number n as a floating-point number* is the string obtained from running [ToString\(n\)](#). The abstract operation [ToString](#) is not uniquely determined. When there are multiple possible strings that could be obtained from [ToString](#) for a particular value, the user agent must always return the same string for that value (though it may differ from the value used by other user agents).

The *rules for parsing floating-point number values* are as given in the following algorithm. This algorithm must be aborted at the first step that returns something. This algorithm will return either a number or an error.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Let *value* have the value 1.
4. Let *divisor* have the value 1.
5. Let *exponent* have the value 1.
6. [Skip ASCII whitespace](#) within *input* given *position*.
7. If *position* is past the end of *input*, return an error.

8. If the character indicated by *position* is a U+002D HYPHEN-MINUS character (-):

1. Change *value* and *divisor* to -1.
2. Advance *position* to the next character.
3. If *position* is past the end of *input*, return an error.

Otherwise, if the character indicated by *position* (the first character) is a U+002B PLUS SIGN character (+):

1. Advance *position* to the next character. (The "+" is ignored, but it is not conforming.)
2. If *position* is past the end of *input*, return an error.
9. If the character indicated by *position* is a U+002E FULL STOP (.), and that is not the last character in *input*, and the character after the character indicated by *position* is an [ASCII digit](#), then set *value* to zero and jump to the step labeled *fraction*.
10. If the character indicated by *position* is not an [ASCII digit](#), then return an error.
11. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, and interpret the resulting sequence as a base-ten integer. Multiply *value* by that integer.
12. If *position* is past the end of *input*, jump to the step labeled *conversion*.
13. *Fraction*: If the character indicated by *position* is a U+002E FULL STOP (.), run these substeps:
 1. Advance *position* to the next character.
 2. If *position* is past the end of *input*, or if the character indicated by *position* is not an [ASCII digit](#), U+0065 LATIN SMALL LETTER E (e), or U+0045 LATIN CAPITAL LETTER E (E), then jump to the step labeled *conversion*.
 3. If the character indicated by *position* is a U+0065 LATIN SMALL LETTER E character (e) or a U+0045 LATIN CAPITAL LETTER E character (E), skip the remainder of these substeps.
 4. *Fraction loop*: Multiply *divisor* by ten.
 5. Add the value of the character indicated by *position*, interpreted as a base-ten digit (0..9) and divided by *divisor*, to *value*.
 6. Advance *position* to the next character.
 7. If *position* is past the end of *input*, then jump to the step labeled *conversion*.
 8. If the character indicated by *position* is an [ASCII digit](#), jump back to the step labeled *fraction loop* in these substeps.

14. If the character indicated by *position* is U+0065 (e) or a U+0045 (E), then:
 1. Advance *position* to the next character.
 2. If *position* is past the end of *input*, then jump to the step labeled *conversion*.
 3. If the character indicated by *position* is a U+002D HYPHEN-MINUS character (-):
 1. Change *exponent* to -1.
 2. Advance *position* to the next character.
 3. If *position* is past the end of *input*, then jump to the step labeled *conversion*.
- Otherwise, if the character indicated by *position* is a U+002B PLUS SIGN character (+):
1. Advance *position* to the next character.
 2. If *position* is past the end of *input*, then jump to the step labeled *conversion*.
 4. If the character indicated by *position* is not an [ASCII digit](#), then jump to the step labeled *conversion*.
 5. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, and interpret the resulting sequence as a base-ten integer. Multiply *exponent* by that integer.
 6. Multiply *value* by ten raised to the *exponent*th power.
 15. *Conversion:* Let *S* be the set of finite IEEE 754 double-precision floating-point values except -0, but with two special values added: 2^{1024} and -2^{1024} .
 16. Let *rounded-value* be the number in *S* that is closest to *value*, selecting the number with an even significand if there are two equally close values. (The two special values 2^{1024} and -2^{1024} are considered to have even significands for this purpose.)
 17. If *rounded-value* is 2^{1024} or -2^{1024} , return an error.
 18. Return *rounded-value*.

2.3.4.4 Percentages and lengths

The rules for parsing dimension values are as given in the following algorithm. When invoked, the steps must be followed in the order given, aborting at the first step that returns a value.

This algorithm will return either a number greater than or equal to 0.0, or failure; if a number is returned, then it is further categorized as either a percentage or a length.

1. Let *input* be the string being parsed.
2. Let *position* be a [position variable](#) for *input*, initially pointing at the start of *input*.
3. [Skip ASCII whitespace](#) within *input* given *position*.
4. If *position* is past the end of *input* or the code point at *position* within *input* is not an [ASCII digit](#), then return failure.
5. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, and interpret the resulting sequence as a base-ten integer. Let *value* be that number.
6. If *position* is past the end of *input*, then return *value* as a length.
7. If the code point at *position* within *input* is U+002E (.), then:
 1. Advance *position* by 1.
 2. If *position* is past the end of *input* or the code point at *position* within *input* is not an [ASCII digit](#), then return the [current dimension value](#) with *value*, *input*, and *position*.
 3. Let *divisor* have the value 1.
 4. While true:
 1. Multiply *divisor* by ten.
 2. Add the value of the code point at *position* within *input*, interpreted as a base-ten digit (0..9) and divided by *divisor*, to *value*.
 3. Advance *position* by 1.
 4. If *position* is past the end of *input*, then return *value* as a length.
 5. If the code point at *position* within *input* is not an [ASCII digit](#), then [break](#).
 8. Return the [current dimension value](#) with *value*, *input*, and *position*.

The *current dimension value*, given *value*, *input*, and *position*, is determined as follows:

1. If *position* is past the end of *input*, then return *value* as a length.
2. If the code point at *position* within *input* is U+0025 (%), then return *value* as a

percentage.

3. Return *value* as a length.

2.3.4.5 Nonzero percentages and lengths

The *rules for parsing nonzero dimension values* are as given in the following algorithm. When invoked, the steps must be followed in the order given, aborting at the first step that returns a value. This algorithm will return either a number greater than 0.0, or an error; if a number is returned, then it is further categorized as either a percentage or a length.

1. Let *input* be the string being parsed.
2. Let *value* be the result of parsing *input* using the [rules for parsing dimension values](#).
3. If *value* is an error, return an error.
4. If *value* is zero, return an error.
5. If *value* is a percentage, return *value* as a percentage.
6. Return *value* as a length.

2.3.4.6 Lists of floating-point numbers

A *valid list of floating-point numbers* is a number of [valid floating-point numbers](#) separated by U+002C COMMA characters, with no other characters (e.g. no [ASCII whitespace](#)). In addition, there might be restrictions on the number of floating-point numbers that can be given, or on the range of values allowed.

The *rules for parsing a list of floating-point numbers* are as follows:

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Let *numbers* be an initially empty list of floating-point numbers. This list will be the result of this algorithm.
4. [Collect a sequence of code points](#) that are [ASCII whitespace](#), U+002C COMMA, or U+003B SEMICOLON characters from *input* given *position*. This skips past any leading delimiters.
5. While *position* is not past the end of *input*:
 1. [Collect a sequence of code points](#) that are not [ASCII whitespace](#), U+002C COMMA, U+003B SEMICOLON, [ASCII digits](#), U+002E FULL STOP, or U+002D HYPHEN-MINUS characters from *input* given *position*. This skips past leading

garbage.

2. [Collect a sequence of code points](#) that are not [ASCII whitespace](#), U+002C COMMA, or U+003B SEMICOLON characters from *input* given *position*, and let *unparsed number* be the result.
3. Let *number* be the result of parsing *unparsed number* using the [rules for parsing floating-point number values](#).
4. If *number* is an error, set *number* to zero.
5. Append *number* to *numbers*.
6. [Collect a sequence of code points](#) that are [ASCII whitespace](#), U+002C COMMA, or U+003B SEMICOLON characters from *input* given *position*. This skips past the delimiter.
6. Return *numbers*.

2.3.4.7 Lists of dimensions

The *rules for parsing a list of dimensions* are as follows. These rules return a list of zero or more pairs consisting of a number and a unit, the unit being one of *percentage*, *relative*, and *absolute*.

1. Let *raw input* be the string being parsed.
2. If the last character in *raw input* is a U+002C COMMA character (,), then remove that character from *raw input*.
3. [Split the string raw input on commas](#). Let *raw tokens* be the resulting list of tokens.
4. Let *result* be an empty list of number/unit pairs.
5. For each token in *raw tokens*, run the following substeps:
 1. Let *input* be the token.
 2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
 3. Let *value* be the number 0.
 4. Let *unit* be *absolute*.
 5. If *position* is past the end of *input*, set *unit* to *relative* and jump to the last substep.
 6. If the character at *position* is an [ASCII digit](#), [collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, interpret the resulting sequence

as an integer in base ten, and increment *value* by that integer.

7. If the character at *position* is U+002E (.), then:
 1. Collect a sequence of code points consisting of [ASCII whitespace](#) and [ASCII digits](#) from *input* given *position*. Let *s* be the resulting sequence.
 2. Remove all [ASCII whitespace](#) in *s*.
 3. If *s* is not the empty string, then:
 1. Let *length* be the number of characters in *s* (after the spaces were removed).
 2. Let *fraction* be the result of interpreting *s* as a base-ten integer, and then dividing that number by $10^{\textit{length}}$.
 3. Increment *value* by *fraction*.
8. Skip ASCII whitespace within *input* given *position*.
9. If the character at *position* is a U+0025 PERCENT SIGN character (%), then set *unit* to *percentage*.
Otherwise, if the character at *position* is a U+002A ASTERISK character (*), then set *unit* to *relative*.
10. Add an entry to *result* consisting of the number given by *value* and the unit given by *unit*.
6. Return the list *result*.

2.3.5 Dates and times

In the algorithms below, the *number of days in month month of year year* is: 31 if *month* is 1, 3, 5, 7, 8, 10, or 12; 30 if *month* is 4, 6, 9, or 11; 29 if *month* is 2 and *year* is a number divisible by 400, or if *year* is a number divisible by 4 but not by 100; and 28 otherwise. This takes into account leap years in the Gregorian calendar. [\[GREGORIAN\]](#)

When [ASCII digits](#) are used in the date and time syntaxes defined in this section, they express numbers in base ten.

While the formats described here are intended to be subsets of the corresponding ISO8601 formats, this specification defines parsing rules in much more detail than ISO8601.

Implementers are therefore encouraged to carefully examine any date parsing libraries before using them to implement the parsing rules described below; ISO8601 libraries might not parse dates and times in exactly the same manner. [\[ISO8601\]](#)

Where this specification refers to the *proleptic Gregorian calendar*, it means the modern Gregorian calendar, extrapolated backwards to year 1. A date in the [proleptic Gregorian calendar](#), sometimes explicitly referred to as a *proleptic-Gregorian date*, is one that is described using that calendar even if that calendar was not in use at the time (or place) in question. [\[GREGORIAN\]](#)

The use of the Gregorian calendar as the wire format in this specification is an arbitrary choice resulting from the cultural biases of those involved in the decision. See also the section discussing [date, time, and number formats](#) in forms (for authors), [implementation notes regarding localization of form controls](#), and the [time](#) element.

2.3.5.1 Months

A *month* consists of a specific [proleptic-Gregorian date](#) with no time-zone information and no date information beyond a year and a month. [\[GREGORIAN\]](#)

A string is a *valid month string* representing a year *year* and month *month* if it consists of the following components in the given order:

1. Four or more [ASCII digits](#), representing *year*, where $year > 0$
2. A U+002D HYPHEN-MINUS character (-)
3. Two [ASCII digits](#), representing the month *month*, in the range $1 \leq month \leq 12$

The rules to *parse a month string* are as follows. This will return either a year and month, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. [Parse a month component](#) to obtain *year* and *month*. If this returns nothing, then fail.
4. If *position* is *not* beyond the end of *input*, then fail.
5. Return *year* and *month*.

The rules to *parse a month component*, given an *input* string and a *position*, are as follows. This will return either a year and a month, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*. If the collected sequence is not at least four characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *year*.
2. If *year* is not a number greater than zero, then fail.
3. If *position* is beyond the end of *input* or if the character at *position* is not a U+002D

HYPHEN-MINUS character, then fail. Otherwise, move *position* forwards one character.

4. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *month*.
5. If *month* is not a number in the range $1 \leq month \leq 12$, then fail.
6. Return *year* and *month*.

2.3.5.2 Dates

A *date* consists of a specific [proleptic-Gregorian date](#) with no time-zone information, consisting of a year, a month, and a day. [\[GREGORIAN\]](#)

A string is a *valid date string* representing a year *year*, month *month*, and day *day* if it consists of the following components in the given order:

1. A [valid month string](#), representing *year* and *month*
2. A U+002D HYPHEN-MINUS character (-)
3. Two [ASCII digits](#), representing *day*, in the range $1 \leq day \leq maxday$ where *maxday* is the [number of days in the month *month* and year *year*](#)

The rules to *parse a date string* are as follows. This will return either a date, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. [Parse a date component](#) to obtain *year*, *month*, and *day*. If this returns nothing, then fail.
4. If *position* is *not* beyond the end of *input*, then fail.
5. Let *date* be the date with year *year*, month *month*, and day *day*.
6. Return *date*.

The rules to *parse a date component*, given an *input* string and a *position*, are as follows. This will return either a year, a month, and a day, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. [Parse a month component](#) to obtain *year* and *month*. If this returns nothing, then fail.
2. Let *maxday* be the [number of days in month *month* of year *year*](#).

3. If *position* is beyond the end of *input* or if the character at *position* is not a U+002D HYPHEN-MINUS character, then fail. Otherwise, move *position* forwards one character.
4. Collect a sequence of code points that are ASCII digits from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *day*.
5. If *day* is not a number in the range $1 \leq day \leq maxday$, then fail.
6. Return *year*, *month*, and *day*.

2.3.5.3 Yearless dates

A *yearless date* consists of a Gregorian month and a day within that month, but with no associated year. [\[GREGORIAN\]](#)

A string is a *valid yearless date string* representing a month *month* and a day *day* if it consists of the following components in the given order:

1. Optionally, two U+002D HYPHEN-MINUS characters (-)
2. Two ASCII digits, representing the month *month*, in the range $1 \leq month \leq 12$
3. A U+002D HYPHEN-MINUS character (-)
4. Two ASCII digits, representing *day*, in the range $1 \leq day \leq maxday$ where *maxday* is the number of days in the month *month* and any arbitrary leap year (e.g. 4 or 2000)

In other words, if the *month* is "02", meaning February, then the day can be 29, as if the year was a leap year.

The rules to *parse a yearless date string* are as follows. This will return either a month and a day, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Parse a yearless date component to obtain *month* and *day*. If this returns nothing, then fail.
4. If *position* is *not* beyond the end of *input*, then fail.
5. Return *month* and *day*.

The rules to *parse a yearless date component*, given an *input* string and a *position*, are as follows. This will return either a month and a day, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Collect a sequence of code points that are U+002D HYPHEN-MINUS characters (-) from

input given *position*. If the collected sequence is not exactly zero or two characters long, then fail.

2. Collect a sequence of code points that are ASCII digits from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *month*.
3. If *month* is not a number in the range $1 \leq month \leq 12$, then fail.
4. Let *maxday* be the number of days in month *month* of any arbitrary leap year (e.g. 4 or 2000).
5. If *position* is beyond the end of *input* or if the character at *position* is not a U+002D HYPHEN-MINUS character, then fail. Otherwise, move *position* forwards one character.
6. Collect a sequence of code points that are ASCII digits from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *day*.
7. If *day* is not a number in the range $1 \leq day \leq maxday$, then fail.
8. Return *month* and *day*.

2.3.5.4 Times

A *time* consists of a specific time with no time-zone information, consisting of an hour, a minute, a second, and a fraction of a second.

A string is a *valid time string* representing an hour *hour*, a minute *minute*, and a second *second* if it consists of the following components in the given order:

1. Two ASCII digits, representing *hour*, in the range $0 \leq hour \leq 23$
2. A U+003A COLON character (:)
3. Two ASCII digits, representing *minute*, in the range $0 \leq minute \leq 59$
4. If *second* is nonzero, or optionally if *second* is zero:
 1. A U+003A COLON character (:)
 2. Two ASCII digits, representing the integer part of *second*, in the range $0 \leq s \leq 59$
 3. If *second* is not an integer, or optionally if *second* is an integer:
 1. A U+002E FULL STOP character (.)
 2. One, two, or three ASCII digits, representing the fractional part of *second*

The *second* component cannot be 60 or 61; leap seconds cannot be represented.

The rules to *parse a time string* are as follows. This will return either a time, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. [Parse a time component](#) to obtain *hour*, *minute*, and *second*. If this returns nothing, then fail.
4. If *position* is not beyond the end of *input*, then fail.
5. Let *time* be the time with hour *hour*, minute *minute*, and second *second*.
6. Return *time*.

The rules to *parse a time component*, given an *input* string and a *position*, are as follows. This will return either an hour, a minute, and a second, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *hour*.
2. If *hour* is not a number in the range $0 \leq \text{hour} \leq 23$, then fail.
3. If *position* is beyond the end of *input* or if the character at *position* is not a U+003A COLON character, then fail. Otherwise, move *position* forwards one character.
4. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *minute*.
5. If *minute* is not a number in the range $0 \leq \text{minute} \leq 59$, then fail.
6. Let *second* be 0.
7. If *position* is not beyond the end of *input* and the character at *position* is U+003A (:), then:
 1. Advance *position* to the next character in *input*.
 2. If *position* is beyond the end of *input*, or at the last character in *input*, or if the next two characters in *input* starting at *position* are not both [ASCII digits](#), then fail.
 3. [Collect a sequence of code points](#) that are either [ASCII digits](#) or U+002E FULL STOP characters from *input* given *position*. If the collected sequence is three characters long, or if it is longer than three characters long and the third character is not a U+002E FULL STOP character, or if it has more than one U+002E FULL STOP character, then fail. Otherwise, interpret the resulting

sequence as a base-ten number (possibly with a fractional part). Set *second* to that number.

4. If *second* is not a number in the range $0 \leq \text{second} < 60$, then fail.
8. Return *hour*, *minute*, and *second*.

2.3.5.5 Local dates and times

A *local date and time* consists of a specific [proleptic-Gregorian date](#), consisting of a year, a month, and a day, and a time, consisting of an hour, a minute, a second, and a fraction of a second, but expressed without a time zone. [\[GREGORIAN\]](#)

A string is a *valid local date and time string* representing a date and time if it consists of the following components in the given order:

1. A [valid date string](#) representing the date
2. A U+0054 LATIN CAPITAL LETTER T character (T) or a U+0020 SPACE character
3. A [valid time string](#) representing the time

A string is a *valid normalized local date and time string* representing a date and time if it consists of the following components in the given order:

1. A [valid date string](#) representing the date
2. A U+0054 LATIN CAPITAL LETTER T character (T)
3. A [valid time string](#) representing the time, expressed as the shortest possible string for the given time (e.g. omitting the seconds component entirely if the given time is zero seconds past the minute)

The rules to *parse a local date and time string* are as follows. This will return either a date and time, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. [Parse a date component](#) to obtain *year*, *month*, and *day*. If this returns nothing, then fail.
4. If *position* is beyond the end of *input* or if the character at *position* is neither a U+0054 LATIN CAPITAL LETTER T character (T) nor a U+0020 SPACE character, then fail. Otherwise, move *position* forwards one character.
5. [Parse a time component](#) to obtain *hour*, *minute*, and *second*. If this returns nothing, then fail.
6. If *position* is not beyond the end of *input*, then fail.

7. Let *date* be the date with year *year*, month *month*, and day *day*.
8. Let *time* be the time with hour *hour*, minute *minute*, and second *second*.
9. Return *date* and *time*.

2.3.5.6 Time zones

A *time-zone offset* consists of a signed number of hours and minutes.

A string is a *valid time-zone offset string* representing a time-zone offset if it consists of either:

- A U+005A LATIN CAPITAL LETTER Z character (Z), allowed only if the time zone is UTC
- Or, the following components, in the given order:
 1. Either a U+002B PLUS SIGN character (+) or, if the time-zone offset is not zero, a U+002D HYPHEN-MINUS character (-), representing the sign of the time-zone offset
 2. Two [ASCII digits](#), representing the hours component *hour* of the time-zone offset, in the range $0 \leq \text{hour} \leq 23$
 3. Optionally, a U+003A COLON character (:)
 4. Two [ASCII digits](#), representing the minutes component *minute* of the time-zone offset, in the range $0 \leq \text{minute} \leq 59$

This format allows for time-zone offsets from -23:59 to +23:59. Right now, in practice, the range of offsets of actual time zones is -12:00 to +14:00, and the minutes component of offsets of actual time zones is always either 00, 30, or 45. There is no guarantee that this will remain so forever, however, since time zones are used as political footballs and are thus subject to very whimsical policy decisions.

See also the usage notes and examples in the [global date and time](#) section below for details on using time-zone offsets with historical times that predate the formation of formal time zones.

The rules to *parse a time-zone offset string* are as follows. This will return either a time-zone offset, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. [Parse a time-zone offset component](#) to obtain *timezonehours* and *timezoneminutes*. If this returns nothing, then fail.
4. If *position* is not beyond the end of *input*, then fail.

5. Return the time-zone offset that is $timezone_{hours}$ hours and $timezone_{minutes}$ minutes from UTC.

The rules to parse a time-zone offset component, given an *input* string and a *position*, are as follows. This will return either time-zone hours and time-zone minutes, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. If the character at *position* is a U+005A LATIN CAPITAL LETTER Z character (Z), then:

1. Let $timezone_{hours}$ be 0.
2. Let $timezone_{minutes}$ be 0.
3. Advance *position* to the next character in *input*.

Otherwise, if the character at *position* is either a U+002B PLUS SIGN (+) or a U+002D HYPHEN-MINUS (-), then:

1. If the character at *position* is a U+002B PLUS SIGN (+), let *sign* be "positive". Otherwise, it's a U+002D HYPHEN-MINUS (-); let *sign* be "negative".
2. Advance *position* to the next character in *input*.
3. Collect a sequence of code points that are ASCII digits from *input* given *position*. Let *s* be the collected sequence.
4. If *s* is exactly two characters long, then:
 1. Interpret *s* as a base-ten integer. Let that number be the $timezone_{hours}$.
 2. If *position* is beyond the end of *input* or if the character at *position* is not a U+003A COLON character, then fail. Otherwise, move *position* forwards one character.
 3. Collect a sequence of code points that are ASCII digits from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the $timezone_{minutes}$.

If *s* is exactly four characters long, then:

1. Interpret the first two characters of *s* as a base-ten integer. Let that number be the $timezone_{hours}$.
2. Interpret the last two characters of *s* as a base-ten integer. Let that

number be the $timezone_{minutes}$.

Otherwise, fail.

5. If $timezone_{hours}$ is not a number in the range $0 \leq timezone_{hours} \leq 23$, then fail.
6. If $sign$ is "negative", then negate $timezone_{hours}$.
7. If $timezone_{minutes}$ is not a number in the range $0 \leq timezone_{minutes} \leq 59$, then fail.
8. If $sign$ is "negative", then negate $timezone_{minutes}$.

Otherwise, fail.

2. Return $timezone_{hours}$ and $timezone_{minutes}$.

2.3.5.7 Global dates and times

A *global date and time* consists of a specific [proleptic-Gregorian date](#), consisting of a year, a month, and a day, and a time, consisting of an hour, a minute, a second, and a fraction of a second, expressed with a time-zone offset, consisting of a signed number of hours and minutes.
[\[GREGORIAN\]](#)

A string is a *valid global date and time string* representing a date, time, and a time-zone offset if it consists of the following components in the given order:

1. A [valid date string](#) representing the date
2. A U+0054 LATIN CAPITAL LETTER T character (T) or a U+0020 SPACE character
3. A [valid time string](#) representing the time
4. A [valid time-zone offset string](#) representing the time-zone offset

Times in dates before the formation of UTC in the mid-twentieth century must be expressed and interpreted in terms of UT1 (contemporary Earth solar time at the 0° longitude), not UTC (the approximation of UT1 that ticks in SI seconds). Time before the formation of time zones must be expressed and interpreted as UT1 times with explicit time zones that approximate the contemporary difference between the appropriate local time and the time observed at the location of Greenwich, London.

The following are some examples of dates written as [valid global date and time strings](#).

"0037-12-13 00:00Z"

Midnight in areas using London time on the birthday of Nero (the Roman Emperor). See below for further discussion on which date this actually corresponds to.

"1979-10-14T12:00:00.001-04:00"

One millisecond after noon on October 14th 1979, in the time zone in use on the east coast of the USA during daylight saving time.

"8592-01-01T02:09+02:09"

Midnight UTC on the 1st of January, 8592. The time zone associated with that time is two hours and nine minutes ahead of UTC, which is not currently a real time zone, but is nonetheless allowed.

Several things are notable about these dates:

- Years with fewer than four digits have to be zero-padded. The date "37-12-13" would not be a valid date.
- If the "T" is replaced by a space, it must be a single space character. The string "2001-12-21 12:00Z" (with two spaces between the components) would not be parsed successfully.
- To unambiguously identify a moment in time prior to the introduction of the Gregorian calendar (insofar as moments in time before the formation of UTC can be unambiguously identified), the date has to be first converted to the Gregorian calendar from the calendar in use at the time (e.g. from the Julian calendar). The date of Nero's birth is the 15th of December 37, in the Julian Calendar, which is the 13th of December 37 in the [proleptic Gregorian calendar](#).
- The time and time-zone offset components are not optional.
- Dates before the year one can't be represented as a datetime in this version of HTML.
- Times of specific events in ancient times are, at best, approximations, since time was not well coordinated or measured until relatively recent decades.
- Time-zone offsets differ based on daylight saving time.

The rules to *parse a global date and time string* are as follows. This will return either a time in UTC, with associated time-zone offset information for round-tripping or display purposes, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. [Parse a date component](#) to obtain *year*, *month*, and *day*. If this returns nothing, then fail.
4. If *position* is beyond the end of *input* or if the character at *position* is neither a U+0054 LATIN CAPITAL LETTER T character (T) nor a U+0020 SPACE character, then fail. Otherwise, move *position* forwards one character.
5. [Parse a time component](#) to obtain *hour*, *minute*, and *second*. If this returns nothing, then fail.
6. If *position* is beyond the end of *input*, then fail.
7. [Parse a time-zone offset component](#) to obtain *timezonehours* and *timezoneminutes*. If this returns nothing, then fail.

8. If *position* is not beyond the end of *input*, then fail.
9. Let *time* be the moment in time at year *year*, month *month*, day *day*, hours *hour*, minute *minute*, second *second*, subtracting *timezonehours* hours and *timezoneminutes* minutes. That moment in time is a moment in the UTC time zone.
10. Let *timezone* be *timezonehours* hours and *timezoneminutes* minutes from UTC.
11. Return *time* and *timezone*.

2.3.5.8 Weeks

A week consists of a week-year number and a week number representing a seven-day period starting on a Monday. Each week-year in this calendaring system has either 52 or 53 such seven-day periods, as defined below. The seven-day period starting on the Gregorian date Monday December 29th 1969 (1969-12-29) is defined as week number 1 in week-year 1970. Consecutive weeks are numbered sequentially. The week before the number 1 week in a week-year is the last week in the previous week-year, and vice versa. [\[GREGORIAN\]](#)

A week-year with a number *year* has 53 weeks if it corresponds to either a year *year* in the [proleptic Gregorian calendar](#) that has a Thursday as its first day (January 1st), or a year *year* in the [proleptic Gregorian calendar](#) that has a Wednesday as its first day (January 1st) and where *year* is a number divisible by 400, or a number divisible by 4 but not by 100. All other week-years have 52 weeks.

The *week number of the last day* of a week-year with 53 weeks is 53; the week number of the last day of a week-year with 52 weeks is 52.

The week-year number of a particular day can be different than the number of the year that contains that day in the [proleptic Gregorian calendar](#). The first week in a week-year *y* is the week that contains the first Thursday of the Gregorian year *y*.

For modern purposes, a [week](#) as defined here is equivalent to ISO weeks as defined in ISO 8601. [\[ISO8601\]](#)

A string is a *valid week string* representing a week-year *year* and week *week* if it consists of the following components in the given order:

1. Four or more [ASCII digits](#), representing *year*, where *year* > 0
2. A U+002D HYPHEN-MINUS character (-)
3. A U+0057 LATIN CAPITAL LETTER W character (W)
4. Two [ASCII digits](#), representing the week *week*, in the range $1 \leq \text{week} \leq \text{maxweek}$, where *maxweek* is the [week number of the last day](#) of week-year *year*

The rules to parse a *week string* are as follows. This will return either a week-year number and week number, or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Collect a sequence of code points that are ASCII digits from *input* given *position*. If the collected sequence is not at least four characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *year*.
4. If *year* is not a number greater than zero, then fail.
5. If *position* is beyond the end of *input* or if the character at *position* is not a U+002D HYPHEN-MINUS character, then fail. Otherwise, move *position* forwards one character.
6. If *position* is beyond the end of *input* or if the character at *position* is not a U+0057 LATIN CAPITAL LETTER W character (W), then fail. Otherwise, move *position* forwards one character.
7. Collect a sequence of code points that are ASCII digits from *input* given *position*. If the collected sequence is not exactly two characters long, then fail. Otherwise, interpret the resulting sequence as a base-ten integer. Let that number be the *week*.
8. Let *maxweek* be the week number of the last day of year *year*.
9. If *week* is not a number in the range $1 \leq \text{week} \leq \text{maxweek}$, then fail.
10. If *position* is not beyond the end of *input*, then fail.
11. Return the week-year number *year* and the week number *week*.

2.3.5.9 Durations

A *duration* consists of a number of seconds.

Since months and seconds are not comparable (a month is not a precise number of seconds, but is instead a period whose exact length depends on the precise day from which it is measured) a duration as defined in this specification cannot include months (or years, which are equivalent to twelve months). Only durations that describe a specific number of seconds can be described.

A string is a *valid duration string* representing a duration *t* if it consists of either of the following:

- A literal U+0050 LATIN CAPITAL LETTER P character followed by one or more of the following subcomponents, in the order given, where the number of days, hours, minutes, and seconds corresponds to the same number of seconds as in *t*:
 1. One or more ASCII digits followed by a U+0044 LATIN CAPITAL LETTER D character, representing a number of days.

2. A U+0054 LATIN CAPITAL LETTER T character followed by one or more of the following subcomponents, in the order given:
 1. One or more [ASCII digits](#) followed by a U+0048 LATIN CAPITAL LETTER H character, representing a number of hours.
 2. One or more [ASCII digits](#) followed by a U+004D LATIN CAPITAL LETTER M character, representing a number of minutes.
 3. The following components:
 1. One or more [ASCII digits](#), representing a number of seconds.
 2. Optionally, a U+002E FULL STOP character (.) followed by one, two, or three [ASCII digits](#), representing a fraction of a second.
 3. A U+0053 LATIN CAPITAL LETTER S character.

This, as with a number of other date- and time-related microsyntaxes defined in this specification, is based on one of the formats defined in ISO 8601. [\[ISO8601\]](#)

- One or more [duration time components](#), each with a different [duration time component scale](#), in any order; the sum of the represented seconds being equal to the number of seconds in t .

A *duration time component* is a string consisting of the following components:

1. Zero or more [ASCII whitespace](#).
2. One or more [ASCII digits](#), representing a number of time units, scaled by the [duration time component scale](#) specified (see below) to represent a number of seconds.
3. If the [duration time component scale](#) specified is 1 (i.e. the units are seconds), then, optionally, a U+002E FULL STOP character (.) followed by one, two, or three [ASCII digits](#), representing a fraction of a second.
4. Zero or more [ASCII whitespace](#).
5. One of the following characters, representing the *duration time component scale* of the time unit used in the numeric part of the [duration time component](#):

U+0057 LATIN CAPITAL LETTER W character

U+0077 LATIN SMALL LETTER W character

Weeks. The scale is 604800.

U+0044 LATIN CAPITAL LETTER D character

U+0064 LATIN SMALL LETTER D character

Days. The scale is 86400.

U+0048 LATIN CAPITAL LETTER H character

U+0068 LATIN SMALL LETTER H character

Hours. The scale is 3600.

U+004D LATIN CAPITAL LETTER M character

U+006D LATIN SMALL LETTER M character

Minutes. The scale is 60.

U+0053 LATIN CAPITAL LETTER S character

U+0073 LATIN SMALL LETTER S character

Seconds. The scale is 1.

6. Zero or more [ASCII whitespace](#).

This is not based on any of the formats in ISO 8601. It is intended to be a more human-readable alternative to the ISO 8601 duration format.

The rules to *parse a duration string* are as follows. This will return either a [duration](#) or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Let *months*, *seconds*, and *component count* all be zero.
4. Let *M-disambiguator* be *minutes*.

This flag's other value is *months*. It is used to disambiguate the "M" unit in ISO8601 durations, which use the same unit for months and minutes. Months are not allowed, but are parsed for future compatibility and to avoid misinterpreting ISO8601 durations that would be valid in other contexts.

5. [Skip ASCII whitespace](#) within *input* given *position*.
6. If *position* is past the end of *input*, then fail.
7. If the character in *input* pointed to by *position* is a U+0050 LATIN CAPITAL LETTER P character, then advance *position* to the next character, set *M-disambiguator* to *months*, and [skip ASCII whitespace](#) within *input* given *position*.
8. While true:

1. Let *units* be undefined. It will be assigned one of the following values: *years*, *months*, *weeks*, *days*, *hours*, *minutes*, and *seconds*.
2. Let *next character* be undefined. It is used to process characters from the *input*.
3. If *position* is past the end of *input*, then break.
4. If the character in *input* pointed to by *position* is a U+0054 LATIN CAPITAL LETTER T character, then advance *position* to the next character, set *M-disambiguator* to *minutes*, [skip ASCII whitespace](#) within *input* given *position*, and [continue](#).
5. Set *next character* to the character in *input* pointed to by *position*.
6. If *next character* is a U+002E FULL STOP character (.), then let *N* equal zero. (Do not advance *position*. That is taken care of below.)

Otherwise, if *next character* is an [ASCII digit](#), then [collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, interpret the resulting sequence as a base-ten integer, and let *N* be that number.

Otherwise *next character* is not part of a number; fail.

7. If *position* is past the end of *input*, then fail.
8. Set *next character* to the character in *input* pointed to by *position*, and this time advance *position* to the next character. (If *next character* was a U+002E FULL STOP character (.) before, it will still be that character this time.)
9. If *next character* is U+002E (.), then:
 1. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*. Let *s* be the resulting sequence.
 2. If *s* is the empty string, then fail.
 3. Let *length* be the number of characters in *s*.
 4. Let *fraction* be the result of interpreting *s* as a base-ten integer, and then dividing that number by 10^{length} .
 5. Increment *N* by *fraction*.
 6. [Skip ASCII whitespace](#) within *input* given *position*.
 7. If *position* is past the end of *input*, then fail.
 8. Set *next character* to the character in *input* pointed to by *position*, and

advance *position* to the next character.

9. If *next character* is neither a U+0053 LATIN CAPITAL LETTER S character nor a U+0073 LATIN SMALL LETTER S character, then fail.
10. Set *units* to *seconds*.

Otherwise:

1. If *next character* is [ASCII whitespace](#), then [skip ASCII whitespace](#) within *input* given *position*, set *next character* to the character in *input* pointed to by *position*, and advance *position* to the next character.
2. If *next character* is a U+0059 LATIN CAPITAL LETTER Y character, or a U+0079 LATIN SMALL LETTER Y character, set *units* to *years* and set *M-disambiguator* to *months*.

If *next character* is a U+004D LATIN CAPITAL LETTER M character or a U+006D LATIN SMALL LETTER M character, and *M-disambiguator* is *months*, then set *units* to *months*.

If *next character* is a U+0057 LATIN CAPITAL LETTER W character or a U+0077 LATIN SMALL LETTER W character, set *units* to *weeks* and set *M-disambiguator* to *minutes*.

If *next character* is a U+0044 LATIN CAPITAL LETTER D character or a U+0064 LATIN SMALL LETTER D character, set *units* to *days* and set *M-disambiguator* to *minutes*.

If *next character* is a U+0048 LATIN CAPITAL LETTER H character or a U+0068 LATIN SMALL LETTER H character, set *units* to *hours* and set *M-disambiguator* to *minutes*.

If *next character* is a U+004D LATIN CAPITAL LETTER M character or a U+006D LATIN SMALL LETTER M character, and *M-disambiguator* is *minutes*, then set *units* to *minutes*.

If *next character* is a U+0053 LATIN CAPITAL LETTER S character or a U+0073 LATIN SMALL LETTER S character, set *units* to *seconds* and set *M-disambiguator* to *minutes*.

Otherwise if *next character* is none of the above characters, then fail.

10. Increment *component count*.
11. Let *multiplier* be 1.
12. If *units* is *years*, multiply *multiplier* by 12 and set *units* to *months*.

13. If *units* is *months*, add the product of *N* and *multiplier* to *months*.

Otherwise:

1. If *units* is *weeks*, multiply *multiplier* by 7 and set *units* to *days*.
2. If *units* is *days*, multiply *multiplier* by 24 and set *units* to *hours*.
3. If *units* is *hours*, multiply *multiplier* by 60 and set *units* to *minutes*.
4. If *units* is *minutes*, multiply *multiplier* by 60 and set *units* to *seconds*.
5. Forcibly, *units* is now *seconds*. Add the product of *N* and *multiplier* to *seconds*.

14. [Skip ASCII whitespace](#) within *input* given *position*.

9. If *component count* is zero, fail.

10. If *months* is not zero, fail.

11. Return the [duration](#) consisting of *seconds* seconds.

2.3.5.10 Vaguer moments in time

A string is a *valid date string with optional time* if it is also one of the following:

- A [valid date string](#)
 - A [valid global date and time string](#)
-

The rules to *parse a date or time string* are as follows. The algorithm will return either a [date](#), a [time](#), a [global date and time](#), or nothing. If at any point the algorithm says that it "fails", this means that it is aborted at that point and returns nothing.

1. Let *input* be the string being parsed.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Set *start position* to the same position as *position*.
4. Set the *date present* and *time present* flags to true.
5. [Parse a date component](#) to obtain *year*, *month*, and *day*. If this fails, then set the *date present* flag to false.
6. If *date present* is true, and *position* is not beyond the end of *input*, and the character at *position* is either a U+0054 LATIN CAPITAL LETTER T character (T) or a U+0020

SPACE character, then advance *position* to the next character in *input*.

Otherwise, if *date present* is true, and either *position* is beyond the end of *input* or the character at *position* is neither a U+0054 LATIN CAPITAL LETTER T character (T) nor a U+0020 SPACE character, then set *time present* to false.

Otherwise, if *date present* is false, set *position* back to the same position as *start position*.

7. If the *time present* flag is true, then [parse a time component](#) to obtain *hour*, *minute*, and *second*. If this returns nothing, then fail.
8. If the *date present* and *time present* flags are both true, but *position* is beyond the end of *input*, then fail.
9. If the *date present* and *time present* flags are both true, [parse a time-zone offset component](#) to obtain *timezone_{hours}* and *timezone_{minutes}*. If this returns nothing, then fail.
10. If *position* is not beyond the end of *input*, then fail.
11. If the *date present* flag is true and the *time present* flag is false, then let *date* be the date with year *year*, month *month*, and day *day*, and return *date*.

Otherwise, if the *time present* flag is true and the *date present* flag is false, then let *time* be the time with hour *hour*, minute *minute*, and second *second*, and return *time*.

Otherwise, let *time* be the moment in time at year *year*, month *month*, day *day*, hours *hour*, minute *minute*, second *second*, subtracting *timezone_{hours}* hours and *timezone_{minutes}* minutes, that moment in time being a moment in the UTC time zone; let *timezone* be *timezone_{hours}* hours and *timezone_{minutes}* minutes from UTC; and return *time* and *timezone*.

2.3.6 Colors

A *simple color* consists of three 8-bit numbers in the range 0 to 255, inclusive, representing the red, green, and blue components of the color respectively, in the '[srgb](#)' color space.

A string is a *valid simple color* if it is exactly seven characters long, and the first character is a U+0023 NUMBER SIGN character (#), and the remaining six characters are all [ASCII hex digits](#), with the first two digits representing the red component, the middle two digits representing the green component, and the last two digits representing the blue component, in hexadecimal.

A string is a *valid lowercase simple color* if it is a [valid simple color](#) and doesn't use any characters in the range U+0041 LATIN CAPITAL LETTER A to U+0046 LATIN CAPITAL LETTER F.

The *rules for parsing simple color values* are as given in the following algorithm. When invoked, the steps must be followed in the order given, aborting at the first step that returns a value. This algorithm will return either a [simple color](#) or an error.

1. Let *input* be the string being parsed.
2. If *input* is not exactly seven characters long, then return an error.
3. If the first character in *input* is not a U+0023 NUMBER SIGN character (#), then return an error.
4. If the last six characters of *input* are not all [ASCII hex digits](#), then return an error.
5. Let *result* be a [simple color](#).
6. Interpret the second and third characters as a hexadecimal number and let the result be the red component of *result*.
7. Interpret the fourth and fifth characters as a hexadecimal number and let the result be the green component of *result*.
8. Interpret the sixth and seventh characters as a hexadecimal number and let the result be the blue component of *result*.
9. Return *result*.

The *rules for serializing simple color values* given a [simple color](#) are as given in the following algorithm:

1. Let *result* be a string consisting of a single U+0023 NUMBER SIGN character (#).
 2. Convert the red, green, and blue components in turn to two-digit hexadecimal numbers using [ASCII lower hex digits](#), zero-padding if necessary, and append these numbers to *result*, in the order red, green, blue.
 3. Return *result*, which will be a [valid lowercase simple color](#).
-

Some obsolete legacy attributes parse colors in a more complicated manner, using the *rules for parsing a legacy color value*, which are given in the following algorithm. When invoked, the steps must be followed in the order given, aborting at the first step that returns a value. This algorithm will return either a [simple color](#) or an error.

1. Let *input* be the string being parsed.
2. If *input* is the empty string, then return an error.
3. [Strip leading and trailing ASCII whitespace](#) from *input*.

4. If *input* is an [ASCII case-insensitive](#) match for the string "transparent", then return an error.
5. If *input* is an [ASCII case-insensitive](#) match for one of the [named colors](#), then return the [simple color](#) corresponding to that keyword. [\[CSSCOLOR\]](#)
[CSS2 System Colors](#) are not recognized.
6. If *input*'s [code point length](#) is four, and the first character in *input* is U+0023 (#), and the last three characters of *input* are all [ASCII hex digits](#), then:
 1. Let *result* be a [simple color](#).
 2. Interpret the second character of *input* as a hexadecimal digit; let the red component of *result* be the resulting number multiplied by 17.
 3. Interpret the third character of *input* as a hexadecimal digit; let the green component of *result* be the resulting number multiplied by 17.
 4. Interpret the fourth character of *input* as a hexadecimal digit; let the blue component of *result* be the resulting number multiplied by 17.
 5. Return *result*.
7. Replace any [code points](#) greater than U+FFFF in *input* (i.e., any characters that are not in the basic multilingual plane) with the two-character string "00".
8. If *input*'s [code point length](#) is greater than 128, truncate *input*, leaving only the first 128 characters.
9. If the first character in *input* is a U+0023 NUMBER SIGN character (#), remove it.
10. Replace any character in *input* that is not an [ASCII hex digit](#) with the character U+0030 DIGIT ZERO (0).
11. While *input*'s [code point length](#) is zero or not a multiple of three, append a U+0030 DIGIT ZERO (0) character to *input*.
12. Split *input* into three strings of equal [code point length](#), to obtain three components. Let *length* be the [code point length](#) that all of those components have (one third the [code point length](#) of *input*).
13. If *length* is greater than 8, then remove the leading *length*-8 characters in each component, and let *length* be 8.
14. While *length* is greater than two and the first character in each component is a U+0030 DIGIT ZERO (0) character, remove that character and reduce *length* by one.

15. If *length* is *still* greater than two, truncate each component, leaving only the first two characters in each.
 16. Let *result* be a [simple color](#).
 17. Interpret the first component as a hexadecimal number; let the red component of *result* be the resulting number.
 18. Interpret the second component as a hexadecimal number; let the green component of *result* be the resulting number.
 19. Interpret the third component as a hexadecimal number; let the blue component of *result* be the resulting number.
 20. Return *result*.
-

The [2D graphics context](#) has a separate color syntax that also handles opacity.

2.3.7 Space-separated tokens

A *set of space-separated tokens* is a string containing zero or more words (known as tokens) separated by one or more [ASCII whitespace](#), where words consist of any string of one or more characters, none of which are [ASCII whitespace](#).

A string containing a [set of space-separated tokens](#) may have leading or trailing [ASCII whitespace](#).

An *unordered set of unique space-separated tokens* is a [set of space-separated tokens](#) where none of the tokens are duplicated.

An *ordered set of unique space-separated tokens* is a [set of space-separated tokens](#) where none of the tokens are duplicated but where the order of the tokens is meaningful.

[Sets of space-separated tokens](#) sometimes have a defined set of allowed values. When a set of allowed values is defined, the tokens must all be from that list of allowed values; other values are non-conforming. If no such set of allowed values is provided, then all values are conforming.

How tokens in a [set of space-separated tokens](#) are to be compared (e.g. case-sensitively or not) is defined on a per-set basis.

2.3.8 Comma-separated tokens

A *set of comma-separated tokens* is a string containing zero or more tokens each separated from the next by a single U+002C COMMA character (,), where tokens consist of any string of zero or more characters, neither beginning nor ending with [ASCII whitespace](#), nor containing

any U+002C COMMA characters (,), and optionally surrounded by [ASCII whitespace](#).

For instance, the string " a ,b , ,d d " consists of four tokens: "a", "b", the empty string, and "d d". Leading and trailing whitespace around each token doesn't count as part of the token, and the empty string can be a token.

[Sets of comma-separated tokens](#) sometimes have further restrictions on what consists a valid token. When such restrictions are defined, the tokens must all fit within those restrictions; other values are non-conforming. If no such restrictions are specified, then all values are conforming.

2.3.9 References

A *valid hash-name reference* to an element of type *type* is a string consisting of a U+0023 NUMBER SIGN character (#) followed by a string which exactly matches the value of the **name** attribute of an element with type *type* in the same [tree](#).

The *rules for parsing a hash-name reference* to an element of type *type*, given a context node *scope*, are as follows:

1. If the string being parsed does not contain a U+0023 NUMBER SIGN character, or if the first such character in the string is the last character in the string, then return null.
2. Let *s* be the string from the character immediately after the first U+0023 NUMBER SIGN character in the string being parsed up to the end of that string.
3. Return the first element of type *type* in *scope*'s [tree](#), in [tree order](#), that has an [id](#) or **name** attribute whose value is *s*, or null if there is no such element.

Although [id](#) attributes are accounted for when parsing, they are not used in determining whether a value is a [valid hash-name reference](#). That is, a hash-name reference that refers to an element based on [id](#) is a conformance error (unless that element also has a **name** attribute with the same value).

2.3.10 Media queries

A string is a *valid media query list* if it matches the **<media-query-list>** production of *Media Queries*. [\[MQ\]](#)

A string *matches the environment* of the user if it is the empty string, a string consisting of only [ASCII whitespace](#), or is a media query list that matches the user's environment according to the definitions given in *Media Queries*. [\[MQ\]](#)

2.4 URLs

2.4.1 Terminology

A string is a *valid non-empty URL* if it is a [valid URL string](#) but it is not the empty string.

A string is a *valid URL potentially surrounded by spaces* if, after [stripping leading and trailing ASCII whitespace](#) from it, it is a [valid URL string](#).

A string is a *valid non-empty URL potentially surrounded by spaces* if, after [stripping leading and trailing ASCII whitespace](#) from it, it is a [valid non-empty URL](#).

This specification defines the URL `about:legacy-compat` as a reserved, though unresolvable, [about:](#) URL, for use in [DOCTYPES](#) in [HTML documents](#) when needed for compatibility with XML tools. [\[ABOUT\]](#)

This specification defines the URL `about:html-kind` as a reserved, though unresolvable, [about:](#) URL, that is used as an identifier for kinds of media tracks. [\[ABOUT\]](#)

This specification defines the URL `about:srcdoc` as a reserved, though unresolvable, [about:](#) URL, that is used as the [URL](#) of [iframe srcdoc documents](#). [\[ABOUT\]](#)

The *fallback base URL* of a [Document](#) object *document* is the [URL record](#) obtained by running these steps:

1. If *document* is an [iframe srcdoc document](#), then return the [document base URL](#) of *document*'s [browsing context's container document](#).
2. If *document*'s [URL](#) is `about:blank`, and *document*'s [browsing context's creator base URL](#) is non-null, then return that [creator base URL](#).
3. Return *document*'s [URL](#).

The *document base URL* of a [Document](#) object is the [absolute URL](#) obtained by running these steps:

1. If there is no [base](#) element that has an [href](#) attribute in the [Document](#), then return the [Document's fallback base URL](#).
2. Otherwise, return the [frozen base URL](#) of the first [base](#) element in the [Document](#) that has an [href](#) attribute, in [tree order](#).

A [URL](#) *matches about:blank* if its [scheme](#) is "about", its [path](#) contains a single string "blank", its [username](#) and [password](#) are the empty string, and its [host](#) is null.

Such a URL's [query](#) and [fragment](#) can be non-null. For example, the [URL record](#) created by [parsing "about:blank?foo#bar"](#) [matches about:blank](#).

2.4.2 Parsing URLs

Parsing a URL is the process of taking a string and obtaining the [URL record](#) that it represents. While this process is defined in *URL*, the HTML standard defines a wrapper for convenience. [\[URL\]](#)

This wrapper is only useful when the character encoding for the URL parser has to match that of the document or environment settings object for legacy reasons. When that is not the case the [URL parser](#) can be used directly.

To parse a *URL url*, relative to either a *document* or *environment settings object*, the user agent must use the following steps. Parsing a URL either results in failure or a [resulting URL string](#) and [resulting URL record](#).

1. Let *encoding* be *document's character encoding*, if *document* was given, and *environment settings object's API URL character encoding* otherwise.
2. Let *baseURL* be *document's base URL*, if *document* was given, and *environment settings object's API base URL* otherwise.
3. Let *urlRecord* be the result of applying the [URL parser](#) to *url*, with *baseURL* and *encoding*.
4. If *urlRecord* is failure, then return failure.
5. Let *urlString* be the result of applying the [URL serializer](#) to *urlRecord*.
6. Return *urlString* as the *resulting URL string* and *urlRecord* as the *resulting URL record*.

2.4.3 Dynamic changes to base URLs

When a document's [document base URL](#) changes, all elements in that document are [affected by a base URL change](#).

The following are [base URL change steps](#), which run when an element is [affected by a base URL change](#) (as defined by *DOM*):

If the element creates a [hyperlink](#)

If the [URL](#) identified by the hyperlink is being shown to the user, or if any data derived from that [URL](#) is affecting the display, then the [href](#) attribute should be [reparsed](#) relative to the element's [node document](#) and the UI updated appropriately.

For example, the CSS [:link/:visited pseudo-classes](#) might have been affected.

If the hyperlink has a [ping](#) attribute and its [URL\(s\)](#) are being shown to the user, then the [ping](#) attribute's tokens should be [reparsed](#) relative to the element's [node document](#) and

the UI updated appropriately.

If the element is a **q**, **blockquote**, **ins**, or **del** element with a **cite** attribute

If the [URL](#) identified by the **cite** attribute is being shown to the user, or if any data derived from that [URL](#) is affecting the display, then the [URL](#) should be [reparsed](#) relative to the element's [node document](#) and the UI updated appropriately.

Otherwise

The element is not directly affected.

For instance, changing the base URL doesn't affect the image displayed by **img** elements, although subsequent accesses of the **src** IDL attribute from script will return a new [absolute URL](#) that might no longer correspond to the image being shown.

2.5 Fetching resources

2.5.1 Terminology

A [response](#) whose [type](#) is "basic", "cors", or "default" is *CORS-same-origin*. [\[FETCH\]](#)

A [response](#) whose [type](#) is "opaque" or "opaqueredirect" is *CORS-cross-origin*.

A [response](#)'s *unsafe response* is its [internal response](#) if it has one, and the [response](#) itself otherwise.

To *create a potential-CORS request*, given a *url*, *destination*, *corsAttributeState*, and an optional *same-origin fallback flag*, run these steps:

1. Let *mode* be "no-cors" if *corsAttributeState* is [No CORS](#), and "cors" otherwise.
2. If *same-origin fallback flag* is set and *mode* is "no-cors", set *mode* to "same-origin".
3. Let *credentialsMode* be "include".
4. If *corsAttributeState* is [Anonymous](#), set *credentialsMode* to "same-origin".
5. Let *request* be a new [request](#) whose [URL](#) is *url*, [destination](#) is *destination*, [mode](#) is *mode*, [credentials mode](#) is *credentialsMode*, and whose [use-URL-credentials flag](#) is set.

2.5.2 Determining the type of a resource

The *Content-Type metadata* of a resource must be obtained and interpreted in a manner consistent with the requirements of *MIME Sniffing*. [\[MIMESNIFF\]](#)

The [computed MIME type](#) of a resource must be found in a manner consistent with the

requirements given in *MIME Sniffing*. [\[MIMESNIFF\]](#)

The [rules for sniffing images specifically](#), the [rules for distinguishing if a resource is text or binary](#), and the [rules for sniffing audio and video specifically](#) are also defined in *MIME Sniffing*. These rules return a [MIME type](#) as their result. [\[MIMESNIFF\]](#)

It is imperative that the rules in *MIME Sniffing* be followed exactly. When a user agent uses different heuristics for content type detection than the server expects, security problems can occur. For more details, see *MIME Sniffing*. [\[MIMESNIFF\]](#)

2.5.3 Extracting character encodings from `meta` elements

The *algorithm for extracting a character encoding from a `meta` element*, given a string *s*, is as follows. It either returns a character encoding or nothing.

1. Let *position* be a pointer into *s*, initially pointing at the start of the string.
2. *Loop*: Find the first seven characters in *s* after *position* that are an [ASCII case-insensitive](#) match for the word "`charset`". If no such match is found, return nothing.
3. Skip any [ASCII whitespace](#) that immediately follow the word "`charset`" (there might not be any).
4. If the next character is not a U+003D EQUALS SIGN (=), then move *position* to point just before that next character, and jump back to the step labeled *loop*.
5. Skip any [ASCII whitespace](#) that immediately follow the equals sign (there might not be any).
6. Process the next character as follows:

If it is a U+0022 QUOTATION MARK character ("") and there is a later U+0022 QUOTATION MARK character ("") in *s*

If it is a U+0027 APOSTROPHE character (') and there is a later U+0027 APOSTROPHE character (') in *s*

 Return the result of [getting an encoding](#) from the substring that is between this character and the next earliest occurrence of this character.

If it is an unmatched U+0022 QUOTATION MARK character ("")

If it is an unmatched U+0027 APOSTROPHE character (')

If there is no next character

 Return nothing.

Otherwise

 Return the result of [getting an encoding](#) from the substring that consists of this character up to but not including the first [ASCII whitespace](#) or U+003B SEMICOLON character (;), or the end of *s*, whichever comes first.

This algorithm is distinct from those in the HTTP specifications (for example, HTTP doesn't allow the use of single quotes and requires supporting a backslash-escape mechanism that is not supported by this algorithm). While the algorithm is used in contexts that, historically, were related to HTTP, the syntax as supported by implementations diverged some time ago. [HTTP]

2.5.4 CORS settings attributes



[Attributes/crossorigin](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

A *CORS settings attribute* is an [enumerated attribute](#). The following table lists the keywords and states for the attribute — the states given in the first cell of the rows with keywords give the states to which those keywords map.

State	Keywords	Brief description
<i>Anonymous</i>	<i>use-</i>	Requests for the element will have their mode set to " <code>cors</code> " and their credentials mode set to " <code>same-origin</code> ".
<i>Use Credentials</i>	<i>use-credentials</i>	Requests for the element will have their mode set to " <code>cors</code> " and their credentials mode set to " <code>include</code> ".

The attribute's [invalid value default](#) is the [Anonymous](#) state, and its [missing value default](#) is the [No CORS](#) state. For the purposes of [reflection](#), the [canonical keyword](#) for the [Anonymous](#) state is the [anonymous](#) keyword.

The majority of fetches governed by [CORS settings attributes](#) will be done via the [create a potential-CORS request](#) algorithm.

For more modern features, where the request's [mode](#) is always "`cors`", certain [CORS settings attributes](#) have been repurposed to have a slightly different meaning, wherein they only impact the [request's credentials mode](#). To perform this translation, we define the *CORS settings attribute credentials mode* for a given [CORS settings attribute](#) to be determined by switching on the attribute's state:

[No CORS](#)
[Anonymous](#)
"same-origin"

[Use Credentials](#) "include"

2.5.5 Referrer policy attributes

A *referrer policy attribute* is an [enumerated attribute](#). Each [referrer policy](#), including the empty string, is a keyword for this attribute, mapping to a state of the same name.

The attribute's [invalid value default](#) and [missing value default](#) are both the empty string state.

The impact of these states on the processing model of various [fetches](#) is defined in more detail throughout this specification, in *Fetch*, and in *Referrer Policy*. [\[FETCH\]](#) [\[REFERRERPOLICY\]](#)

Several signals can contribute to which processing model is used for a given [fetch](#); a [referrer policy attribute](#) is only one of them. In general, the order in which these signals are processed are:

1. First, the presence of a [noreferrer](#) link type;
2. Then, the value of a [referrer policy attribute](#);
3. Then, the presence of any [meta](#) element with [name](#) attribute set to [referrer](#).
4. Finally, the '[Referrer-Policy](#)' HTTP header.

2.5.6Nonce attributes



[Global_attributes/nonce](#)

Support in all current engines.

Firefox 31+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) Yes Internet Explorer No

Firefox Android 31+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

A **nonce** content attribute represents a cryptographic nonce ("number used once") which can be used by *Content Security Policy* to determine whether or not a given fetch will be allowed to proceed. The value is text. [\[CSP\]](#)

Elements that have a **nonce** content attribute ensure that the cryptographic nonce is only exposed to script (and not to side-channels like CSS attribute selectors) by taking the value from the content attribute, moving it into an internal slot named `[[CryptographicNonce]]`,

exposing it to script via the [HTMLOrSVGElement](#) interface mixin, and setting the content attribute to the empty string. Unless otherwise specified, the slot's value is the empty string.

`element.nonce`

Returns the value set for *element*'s cryptographic nonce. If the setter was not used, this will be the value originally found in the [nonce](#) content attribute.

`element.nonce = value`

Updates *element*'s cryptographic nonce value.

MDN

[HTMLElement/nonce](#)

Firefox 75+ Safari iOS 10+ Chrome 61+

Opera 48+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 79+ Safari iOS 10+ Chrome Android 61+ WebView Android 61+ Samsung Internet 8.0+ Opera Android 45+

The **nonce** IDL attribute must, on getting, return the value of this element's [\[\[CryptographicNonce\]\]](#); and on setting, set this element's [\[\[CryptographicNonce\]\]](#) to the given value.

Note how the setter for the **nonce** IDL attribute does not update the corresponding content attribute. This, as well as the below setting of the **nonce** content attribute to the empty string when an element [becomes browsing-context connected](#), is meant to prevent exfiltration of the nonce value through mechanisms that can easily read content attributes, such as selectors. Learn more in [issue #2369](#), where this behavior was introduced.

The following [attribute change steps](#) are used for the **nonce** content attribute:

1. If *element* does not [include HTMLOrSVGElement](#), then return.
2. If *localName* is not **nonce** or *namespace* is not null, then return.
3. If *value* is null, then set *element*'s [\[\[CryptographicNonce\]\]](#) to the empty string.
4. Otherwise, set *element*'s [\[\[CryptographicNonce\]\]](#) to *value*.

Whenever an element [including HTMLOrSVGElement becomes browsing-context connected](#), the user agent must execute the following steps on the *element*:

1. Let *CSP list* be *element*'s [shadow-including root](#)'s [policy container](#)'s [CSP list](#).

2. If *CSP list* contains a header-delivered Content Security Policy, and *element* has a [nonce](#) content attribute *attr* whose value is not the empty string, then:

1. Let *nonce* be *element*'s [\[\[CryptographicNonce\]\]](#).
2. Set an attribute value for *element* using "nonce" and the empty string.
3. Set *element*'s [\[\[CryptographicNonce\]\]](#) to *nonce*.

If *element*'s [\[\[CryptographicNonce\]\]](#) were not restored it would be the empty string at this point.

The [cloning steps](#) for elements that [include HTMLOrSVGElement](#) must set the [\[\[CryptographicNonce\]\]](#) slot on the copy to the value of the slot on the element being cloned.

2.5.7 Lazy loading attributes

MDN

[Lazy_loading](#)

Firefox 75+ Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

A *lazy loading attribute* is an [enumerated attribute](#). The following table lists the keywords and states for the attribute — the keywords in the left column map to the states in the cell in the second column on the same row as the keyword.

The attribute directs the user agent to fetch a resource immediately or to defer fetching until some conditions associated with the element are met, according to the attribute's current state.

Keyword	State	Description
lazy	<i>Lazy</i>	Used to defer fetching a resource until some conditions are met.
eager	<i>Eager</i>	Used to fetch a resource immediately; the default state.

The attribute's [missing value default](#) and [invalid value default](#) are both the [Eager](#) state.

The *will lazy load element steps*, given an element *element*, are as follows:

1. If [scripting is disabled](#) for *element*, then return false.

This is an anti-tracking measure, because if a user agent supported lazy loading when

scripting is disabled, it would still be possible for a site to track a user's approximate scroll position throughout a session, by strategically placing images in a page's markup such that a server can track how many images are requested and when.

2. If *element*'s [lazy loading attribute](#) is in the [Lazy](#) state, then return true.
3. Return false.

Each [img](#) and [iframe](#) element has associated *lazy load resumption steps*, initially null.

For [img](#) and [iframe](#) elements that [will lazy load](#), these steps are run from the [lazy load intersection observer](#)'s callback or when their [lazy loading attribute](#) is set to the [Eager](#) state. This causes the element to continue loading.

Each [Document](#) has a *lazy load intersection observer*, initially set to null but can be set to an [IntersectionObserver](#) instance.

To start intersection-observing a lazy loading element *element*, run these steps:

1. Let *doc* be *element*'s [node document](#).
2. If *doc*'s [lazy load intersection observer](#) is null, set it to a new [IntersectionObserver](#) instance, initialized as follows:

The intention is to use the original value of the [IntersectionObserver](#) constructor. However, we're forced to use the JavaScript-exposed constructor in this specification, until *Intersection Observer* exposes low-level hooks for use in specifications. See bug [w3c/IntersectionObserver#464](#) which tracks this. [\[INTERSECTIONOBSERVER\]](#)

- The *callback* is these steps, with arguments *entries* and *observer*:
 1. For each *entry* in *entries* using a method of iteration which does not trigger developer-modifiable array accessors or iteration hooks:
 1. Let *resumptionSteps* be null.
 2. If *entry.isIntersecting* is true, then set *resumptionSteps* to *entry.target*'s [lazy load resumption steps](#).
 3. If *resumptionSteps* is null, then return.
 4. [Stop intersection-observing a lazy loading element](#) for *entry.target*.
 5. Set *entry.target*'s [lazy load resumption steps](#) to null.
 6. Invoke *resumptionSteps*.

The intention is to use the original value of the [isIntersecting](#) and [target](#) getters. See [w3c/IntersectionObserver#464](#).
[INTERSECTIONOBSERVER]

- The *options* is an [IntersectionObserverInit](#) dictionary with the following dictionary members: «["rootMargin" → [lazy load root margin](#)]»

This allows for fetching the image during scrolling, when it does not yet — but is about to — intersect the viewport.

The [lazy load root margin](#) suggestions imply dynamic changes to the value, but the [IntersectionObserver](#) API does not support changing the root margin. See issue [w3c/IntersectionObserver#428](#).

3. Call *doc*'s [lazy load intersection observer](#)'s [observe](#) method with *element* as the argument.

The intention is to use the original value of the [observe](#) method. See [w3c/IntersectionObserver#464](#). [INTERSECTIONOBSERVER]

To stop intersection-observing a lazy loading element *element*, run these steps:

1. Let *doc* be *element*'s [node document](#).
2. Assert: *doc*'s [lazy load intersection observer](#) is not null.
3. Call *doc*'s [lazy load intersection observer](#) [unobserve](#) method with *element* as the argument.

The intention is to use the original value of the [unobserve](#) method. See [w3c/IntersectionObserver#464](#). [INTERSECTIONOBSERVER]

(This
is a
tracking
vector.) The [lazy load root margin](#) is an [implementation-defined](#) value, but with the following suggestions to consider:

- Set a minimum value that most often results in the resources being loaded before they intersect the viewport under normal usage patterns for the given device.
- The typical scrolling speed: increase the value for devices with faster typical scrolling speeds.
- The current scrolling speed or momentum: the UA can attempt to predict where the scrolling will likely stop, and adjust the value accordingly.
- The network quality: increase the value for slow or high-latency connections.

- User preferences can influence the value.

It is important [for privacy](#) that the [lazy load root margin](#) not leak additional information. For example, the typical scrolling speed on the current device could be imprecise so as to not introduce a new fingerprinting vector.

2.6 Common DOM interfaces

2.6.1 Reflecting content attributes in IDL attributes

Some IDL attributes are defined to *reflect* a particular content attribute. This means that on getting, the IDL attribute returns the current value of the content attribute, and on setting, the IDL attribute changes the value of the content attribute to the given value.

In general, on getting, if the content attribute is not present, the IDL attribute must act as if the content attribute's value is the empty string; and on setting, if the content attribute is not present, it must first be added.

If a reflecting IDL attribute is a [USVString](#) attribute whose content attribute is defined to contain a [URL](#), then on getting, if the content attribute is absent, the IDL attribute must return the empty string. Otherwise, the IDL attribute must [parse](#) the value of the content attribute relative to the element's [node document](#) and if that is successful, return the [resulting URL string](#). If parsing fails, then the value of the content attribute must be returned instead, [converted](#) to a [USVString](#). On setting, the content attribute must be set to the specified new value.

If a reflecting IDL attribute is a [DOMString](#) attribute whose content attribute is an [enumerated attribute](#), and the IDL attribute is *limited to only known values*, then, on getting, the IDL attribute must return the keyword value associated with the state the attribute is in, if any, or the empty string if the attribute is in a state that has no associated keyword value or if the attribute is not in a defined state (e.g. the attribute is missing and there is no [missing value default](#)). If there are multiple keyword values for the state, then return the conforming one. If there are multiple conforming keyword values, then one will be designated the *canonical keyword*; choose that one. On setting, the content attribute must be set to the specified new value.

If a reflecting IDL attribute is a nullable [DOMString](#) attribute whose content attribute is an [enumerated attribute](#), then, on getting, if the corresponding content attribute is in its *missing value default* state then the IDL attribute must return null, otherwise, the IDL attribute must return the keyword value associated with the state the attribute is in. If there are multiple keyword values for the state, then return the conforming one. If there are multiple conforming keyword values, then one will be designated the [canonical keyword](#); choose that one. On setting, if the new value is null, the content attribute must be removed, and otherwise, the content attribute must be set to the specified new value.

If a reflecting IDL attribute is a [DOMString](#) or [USVString](#) attribute but doesn't fall into any of the above categories, then the getting and setting must be done in a transparent, case-

preserving manner.

If a reflecting IDL attribute is a [boolean](#) attribute, then on getting, the IDL attribute must return true if the content attribute is set, and false if it is absent. On setting, the content attribute must be removed if the IDL attribute is set to false, and must be set to the empty string if the IDL attribute is set to true. (This corresponds to the rules for [boolean content attributes](#).)

If a reflecting IDL attribute has a signed integer type ([long](#)) then, on getting, the content attribute must be parsed according to the [rules for parsing signed integers](#), and if that is successful, and the value is in the range of the IDL attribute's type, the resulting value must be returned. If, on the other hand, it fails or returns an out of range value, or if the attribute is absent, then the default value must be returned instead, or 0 if there is no default value. On setting, the given value must be converted to the shortest possible string representing the number as a [valid integer](#) and then that string must be used as the new content attribute value.

If a reflecting IDL attribute has a signed integer type ([long](#)) that is *limited to only non-negative numbers* then, on getting, the content attribute must be parsed according to the [rules for parsing non-negative integers](#), and if that is successful, and the value is in the range of the IDL attribute's type, the resulting value must be returned. If, on the other hand, it fails or returns an out of range value, or if the attribute is absent, the default value must be returned instead, or -1 if there is no default value. On setting, if the value is negative, the user agent must throw an ["IndexSizeError" DOMException](#). Otherwise, the given value must be converted to the shortest possible string representing the number as a [valid non-negative integer](#) and then that string must be used as the new content attribute value.

If a reflecting IDL attribute has an *unsigned* integer type ([unsigned long](#)) then, on getting, the content attribute must be parsed according to the [rules for parsing non-negative integers](#), and if that is successful, and the value is in the range 0 to 2147483647 inclusive, the resulting value must be returned. If, on the other hand, it fails or returns an out of range value, or if the attribute is absent, the default value must be returned instead, or 0 if there is no default value. On setting, first, if the new value is in the range 0 to 2147483647, then let n be the new value, otherwise let n be the default value, or 0 if there is no default value; then, n must be converted to the shortest possible string representing the number as a [valid non-negative integer](#) and that string must be used as the new content attribute value.

If a reflecting IDL attribute has an *unsigned* integer type ([unsigned long](#)) that is *limited to only non-negative numbers greater than zero*, then the behavior is similar to the previous case, but zero is not allowed. On getting, the content attribute must first be parsed according to the [rules for parsing non-negative integers](#), and if that is successful, and the value is in the range 1 to 2147483647 inclusive, the resulting value must be returned. If, on the other hand, it fails or returns an out of range value, or if the attribute is absent, the default value must be returned instead, or 1 if there is no default value. On setting, if the value is zero, the user agent must throw an ["IndexSizeError" DOMException](#). Otherwise, first, if the new value is in the range 1 to 2147483647, then let n be the new value, otherwise let n be the default value, or 1 if there is no default value; then, n must be converted to the shortest possible string representing the number as a [valid non-negative integer](#) and that string must be used as the new content

attribute value.

If a reflecting IDL attribute has an unsigned integer type ([unsigned long](#)) that is *limited to only non-negative numbers greater than zero with fallback*, then the behavior is similar to the previous case, but disallowed values are converted to the default value. On getting, the content attribute must first be parsed according to the [rules for parsing non-negative integers](#), and if that is successful, and the value is in the range 1 to 2147483647 inclusive, the resulting value must be returned. If, on the other hand, it fails or returns an out of range value, or if the attribute is absent, the default value must be returned instead. On setting, first, if the new value is in the range 1 to 2147483647, then let n be the new value, otherwise let n be the default value; then, n must be converted to the shortest possible string representing the number as a [valid non-negative integer](#) and that string must be used as the new content attribute value.

If a reflecting IDL attribute has an unsigned integer type ([unsigned long](#)) that is *clamped to the range [min, max]*, then on getting, the content attribute must first be parsed according to the [rules for parsing non-negative integers](#), and if that is successful, and the value is between min and max inclusive, the resulting value must be returned. If it fails, the default value must be returned. If it succeeds but the value is less than min , min must be returned. If it succeeds but the value is greater than max , max must be returned. On setting, it behaves the same as setting a regular reflected unsigned integer.

If a reflecting IDL attribute has a floating-point number type ([double](#) or [unrestricted double](#)), then, on getting, the content attribute must be parsed according to the [rules for parsing floating-point number values](#), and if that is successful, the resulting value must be returned. If, on the other hand, it fails, or if the attribute is absent, the default value must be returned instead, or 0.0 if there is no default value. On setting, the given value must be converted to the [best representation of the number as a floating-point number](#) and then that string must be used as the new content attribute value.

If a reflecting IDL attribute has a floating-point number type ([double](#) or [unrestricted double](#)) that is *limited to numbers greater than zero*, then the behavior is similar to the previous case, but zero and negative values are not allowed. On getting, the content attribute must be parsed according to the [rules for parsing floating-point number values](#), and if that is successful and the value is greater than 0.0, the resulting value must be returned. If, on the other hand, it fails or returns an out of range value, or if the attribute is absent, the default value must be returned instead, or 0.0 if there is no default value. On setting, if the value is less than or equal to zero, then the value must be ignored. Otherwise, the given value must be converted to the [best representation of the number as a floating-point number](#) and then that string must be used as the new content attribute value.

The values Infinity and Not-a-Number (NaN) values throw an exception on setting, as defined in *Web IDL*. [\[WEBIDL\]](#)

If a reflecting IDL attribute has the type [DOMTokenList](#), then on getting it must return a [DOMTokenList](#) object whose associated element is the element in question and whose associated attribute's local name is the name of the attribute in question.

2.6.2 Collections

The [HTMLFormControlsCollection](#) and [HTMLOptionsCollection](#) interfaces are [collections](#) derived from the [HTMLCollection](#) interface. The [HTMLAllCollection](#) interface is a [collection](#), but is not so derived.

2.6.2.1 The [HTMLAllCollection](#) interface

The [HTMLAllCollection](#) interface is used for the legacy [document.all](#) attribute. It operates similarly to [HTMLCollection](#); the main differences are that it allows a staggering variety of different (ab)uses of its methods to all end up returning something, and that it can be called as a function as an alternative to property access.

All [HTMLAllCollection](#) objects are rooted at a [Document](#) and have a filter that matches all elements, so the elements [represented by the collection](#) of an [HTMLAllCollection](#) object consist of all the descendant elements of the root [Document](#).

Objects that implement the [HTMLAllCollection](#) interface are [legacy platform objects](#) with an additional [\[\[Call\]\]](#) internal method described in the [section below](#). They also have an [\[\[IsHTMLDDA\]\]](#) internal slot.

Objects that implement the [HTMLAllCollection](#) interface have several unusual behaviors, due of the fact that they have an [\[\[IsHTMLDDA\]\]](#) internal slot:

- The [ToBoolean](#) abstract operation in JavaScript returns false when given objects implementing the [HTMLAllCollection](#) interface.
- The [Abstract Equality Comparison](#) algorithm, when given objects implementing the [HTMLAllCollection](#) interface, returns true when compared to the [undefined](#) and [null](#) values. (Comparisons using the [Strict Equality Comparison](#) algorithm, and Abstract Equality comparisons to other values such as strings or objects, are unaffected.)
- The [typeof](#) operator in JavaScript returns the string "[undefined](#)" when applied to objects implementing the [HTMLAllCollection](#) interface.

These special behaviors are motivated by a desire for compatibility with two classes of legacy content: one that uses the presence of [document.all](#) as a way to detect legacy user agents, and one that only supports those legacy user agents and uses the [document.all](#) object without testing for its presence first. [\[JAVASCRIPT\]](#)

```
[Exposed=Window,  
LegacyUnenumerableNamedProperties]  
interface HTMLAllCollection {  
    readonly attribute unsigned long length;  
    getter Element (unsigned long index);  
    getter (HTMLCollection or Element)? namedItem(DOMString name);
```

```
(HTMLCollection or Element)? item(optional DOMString nameOrIndex);  
// Note: HTMLAllCollection objects have a custom \[\[Call\]\] internal method  
};
```

The object's [supported property indices](#) are as defined for [HTMLCollection](#) objects.

The [supported property names](#) consist of the non-empty values of all the [id](#) attributes of all the elements [represented by the collection](#), and the non-empty values of all the [name](#) attributes of all the "all"-named elements [represented by the collection](#), in [tree order](#), ignoring later duplicates, with the [id](#) of an element preceding its [name](#) if it contributes both, they differ from each other, and neither is the duplicate of an earlier entry.

The [length](#) getter steps are to return the number of nodes [represented by the collection](#).

The indexed property getter must return the result of [getting the "all"-indexed element](#) from [this](#) given the passed index.

The [namedItem\(name\)](#) method steps are to return the result of [getting the "all"-named element\(s\)](#) from [this](#) given [name](#).

The [item\(nameOrIndex\)](#) method steps are:

1. If [nameOrIndex](#) was not provided, return null.
2. Return the result of [getting the "all"-indexed or named element\(s\)](#) from [this](#), given [nameOrIndex](#).

The following elements are "all"-named elements: [a](#), [button](#), [embed](#), [form](#), [frame](#), [frameset](#), [iframe](#), [img](#), [input](#), [map](#), [meta](#), [object](#), [select](#), and [textarea](#)

To get the "all"-indexed element from an [HTMLAllCollection](#) collection given an index [index](#)th element in [collection](#), return the [index](#)th element in [collection](#), or null if there is no such [index](#)th element.

To get the "all"-named element(s) from an [HTMLAllCollection](#) collection given a name [name](#), perform the following steps:

1. If [name](#) is the empty string, return null.
2. Let [subCollection](#) be an [HTMLCollection](#) object rooted at the same [Document](#) as [collection](#), whose filter matches only elements that are either:
 - ["all"-named elements](#) with a [name](#) attribute equal to [name](#), or,
 - elements with an [ID](#) equal to [name](#).

3. If there is exactly one element in *subCollection*, then return that element.
4. Otherwise, if *subCollection* is empty, return null.
5. Otherwise, return *subCollection*.

To get the "all"-indexed or named element(s) from an [HTMLAllCollection](#) collection given *nameOrIndex*:

1. If *nameOrIndex*, [converted](#) to a JavaScript String value, is an [array index property name](#), return the result of [getting the "all"-indexed element](#) from *collection* given the number represented by *nameOrIndex*.
2. Return the result of [getting the "all"-named element\(s\)](#) from *collection* given *nameOrIndex*.

2.6.2.1.1 [[Call]](*thisArgument*, *argumentsList*)

1. If *argumentsList*'s [size](#) is zero, or if *argumentsList*[0] is undefined, return null.
2. Let *nameOrIndex* be the result of [converting](#) *argumentsList*[0] to a [DOMString](#).
3. Let *result* be the result of [getting the "all"-indexed or named element\(s\)](#) from this [HTMLAllCollection](#) given *nameOrIndex*.
4. Return the result of [converting](#) *result* to an ECMAScript value.

The *thisArgument* is ignored, and thus code such as

`Function.prototype.call.call(document.all, null, "x")` will still search for elements. (`document.all.call` does not exist, since `document.all` does not inherit from `Function.prototype`.)

2.6.2.2 The [HTMLFormControlsCollection](#) interface

The [HTMLFormControlsCollection](#) interface is used for [collections](#) of [listed elements](#) in [form](#) elements.



[HTMLFormControlsCollection](#)

Support in all current engines.

Firefox 27+ Safari 7+ Chrome 25+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android27+Safari iOS7+Chrome Android25+WebView Android37+Samsung Internet1.5+Opera Android14+

[RadioNodeList](#)

Support in all current engines.

Firefox33+Safari10+Chrome34+

Opera21+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android33+Safari iOS9+Chrome Android34+WebView Android37+Samsung Internet2.0+Opera Android21+

[Exposed=Window]

```
interface HTMLFormControlsCollection : HTMLCollection {  
    // inherits length and item\(\)  
    getter (RadioNodeList or Element)? namedItem(DOMString name); // shadows item\(\)  
};
```

[Exposed=Window]

```
interface RadioNodeList : NodeList {  
    attribute DOMString value;  
};
```

[collection.length](#)

Returns the number of elements in *collection*.

element = collection.item(index)
element = collection[index]

Returns the item at index *index* in *collection*. The items are sorted in [tree order](#).

`element = collection.namedItem(name)`

✓MDN

[HTMLFormControlsCollection/namedItem](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 25+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 33+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 14+

`radioNodeList = collection.namedItem(name)`

`element = collection[name]`

`radioNodeList = collection[name]`

Returns the item with [ID](#) or [name](#) *name* from *collection*.

If there are multiple matching items, then a [RadioNodeList](#) object containing all those elements is returned.

`radioNodeList.value`

Returns the value of the first checked radio button represented by *radioNodeList*.

`radioNodeList.value = value`

Checks the first checked radio button represented by *radioNodeList* that has value *value*.

The object's [supported property indices](#) are as defined for [HTMLCollection](#) objects.

The [supported property names](#) consist of the non-empty values of all the [id](#) and [name](#) attributes of all the elements [represented by the collection](#), in [tree order](#), ignoring later duplicates, with the [id](#) of an element preceding its [name](#) if it contributes both, they differ from each other, and neither is the duplicate of an earlier entry.

The [namedItem\(name\)](#) method must act according to the following algorithm:

1. If *name* is the empty string, return null and stop the algorithm.
2. If, at the time the method is called, there is exactly one node in the collection that has either an [id](#) attribute or a [name](#) attribute equal to *name*, then return that node and stop the algorithm.
3. Otherwise, if there are no nodes in the collection that have either an [id](#) attribute or a [name](#) attribute equal to *name*, then return null and stop the algorithm.
4. Otherwise, create a new [RadioNodeList](#) object representing a [live](#) view of the [HTMLFormControlsCollection](#) object, further filtered so that the only nodes in the

[RadioNodeList](#) object are those that have either an [id](#) attribute or a [name](#) attribute equal to *name*. The nodes in the [RadioNodeList](#) object must be sorted in [tree order](#).

5. Return that [RadioNodeList](#) object.
-

Members of the [RadioNodeList](#) interface inherited from the [NodeList](#) interface must behave as they would on a [NodeList](#) object.



[RadioNodeList/value](#)

Support in all current engines.

Firefox 33+ Safari 10+ Chrome 34+

Opera 21+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 33+ Safari iOS 9+ Chrome Android 34+ WebView Android 37+ Samsung

Internet 2.0+ Opera Android 21+

The [value](#) IDL attribute on the [RadioNodeList](#) object, on getting, must return the value returned by running the following steps:

1. Let *element* be the first element in [tree order](#) represented by the [RadioNodeList](#) object that is an [input](#) element whose [type](#) attribute is in the [Radio Button](#) state and whose [checkedness](#) is true. Otherwise, let it be null.
2. If *element* is null, return the empty string.
3. If *element* is an element with no [value](#) attribute, return the string "on".
4. Otherwise, return the value of *element*'s [value](#) attribute.

On setting, the [value](#) IDL attribute must run the following steps:

1. If the new value is the string "on": let *element* be the first element in [tree order](#) represented by the [RadioNodeList](#) object that is an [input](#) element whose [type](#) attribute is in the [Radio Button](#) state and whose [value](#) content attribute is either absent, or present and equal to the new value, if any. If no such element exists, then instead let *element* be null.

Otherwise: let *element* be the first element in [tree order](#) represented by the [RadioNodeList](#) object that is an [input](#) element whose [type](#) attribute is in the [Radio Button](#) state and whose [value](#) content attribute is present and equal to the new value, if any. If no such element exists, then instead let *element* be null.

2. If *element* is not null, then set its [checkedness](#) to true.

2.6.2.3 The [HTMLOptionsCollection](#) interface

✓MDN

[HTMLOptionsCollection](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android Yes

The [HTMLOptionsCollection](#) interface is used for [collections](#) of [option](#) elements. It is always rooted on a [select](#) element and has attributes and methods that manipulate that element's descendants.

```
[Exposed=Window]
interface HTMLOptionsCollection : HTMLCollection {
  // inherits item(), namedItem()
  [CEReactions] attribute unsigned long length; // shadows inherited length
  [CEReactions] setter undefined (unsigned long index, HTMLOptionElement? opt)
  [CEReactions] undefined add((HTMLOptionElement or HTMLOptGroupElement) element);
  [CEReactions] undefined remove(long index);
  attribute long selectedIndex;
};
```

[collection.length](#)

Returns the number of elements in *collection*.

[collection.length = value](#)

When set to a smaller number than the existing length, truncates the number of [option](#) elements in the container corresponding to *collection*.

When set to a greater number than the existing length, adds new blank [option](#) elements to the container corresponding to *collection*.

[element = collection.item\(index\)](#) **[element = collection\[index\]](#)**

Returns the item at index *index* in *collection*. The items are sorted in [tree order](#).

`collection[index] = element`

When *index* is a greater number than the number of items in *collection*, adds new blank [option](#) elements in the corresponding container.

When set to null, removes the item at index *index* from *collection*.

When set to an [option](#) element, adds or replaces it at index *index* in *collection*.

`element = collection.namedItem(name)` **`element = collection[name]`**

Returns the item with [ID](#) or [name](#) *name* from *collection*.

If there are multiple matching items, then the first is returned.

`collection.add(element[, before])`

Inserts *element* before the node given by *before*.

The *before* argument can be a number, in which case *element* is inserted before the item with that number, or an element from *collection*, in which case *element* is inserted before that element.

If *before* is omitted, null, or a number out of range, then *element* will be added at the end of the list.

Throws a "[HierarchyRequestError](#)" [DOMException](#) if *element* is an ancestor of the element into which it is to be inserted.

`collection.remove(index)`

Removes the item with index *index* from *collection*.

`collection.selectedIndex`

Returns the index of the first selected item, if any, or -1 if there is no selected item.

`collection.selectedIndex = index`

Changes the selection to the [option](#) element at index *index* in *collection*.

The object's [supported property indices](#) are as defined for [HTMLCollection](#) objects.

On getting, the *length* attribute must return the number of nodes [represented by the collection](#).

On setting, the behavior depends on whether the new value is equal to, greater than, or less

than the number of nodes [represented by the collection](#) at that time. If the number is the same, then setting the attribute must do nothing. If the new value is greater, then n new [option](#) elements with no attributes and no child nodes must be appended to the [select](#) element on which the [HTMLOptionsCollection](#) is rooted, where n is the difference between the two numbers (new value minus old value). Mutation events must be fired as if a [DocumentFragment](#) containing the new [option](#) elements had been inserted. If the new value is lower, then the last n nodes in the collection must be removed from their parent nodes, where n is the difference between the two numbers (old value minus new value).

Setting [length](#) never removes or adds any [optgroup](#) elements, and never adds new children to existing [optgroup](#) elements (though it can remove children from them).

The [supported property names](#) consist of the non-empty values of all the [id](#) and [name](#) attributes of all the elements [represented by the collection](#), in [tree order](#), ignoring later duplicates, with the [id](#) of an element preceding its [name](#) if it contributes both, they differ from each other, and neither is the duplicate of an earlier entry.

When the user agent is to [set the value of a new indexed property](#) or [set the value of an existing indexed property](#) for a given property index $index$ to a new value $value$, it must run the following algorithm:

1. If $value$ is null, invoke the steps for the [remove](#) method with $index$ as the argument, and return.
2. Let $length$ be the number of nodes [represented by the collection](#).
3. Let n be $index$ minus $length$.
4. If n is greater than zero, then [append](#) a [DocumentFragment](#) consisting of $n-1$ new [option](#) elements with no attributes and no child nodes to the [select](#) element on which the [HTMLOptionsCollection](#) is rooted.
5. If n is greater than or equal to zero, [append](#) $value$ to the [select](#) element. Otherwise, [replace](#) the $index$ th element in the collection by $value$.

The [add\(element, before\)](#) method must act according to the following algorithm:

1. If $element$ is an ancestor of the [select](#) element on which the [HTMLOptionsCollection](#) is rooted, then throw a "[HierarchyRequestError](#)" [DOMException](#).
2. If $before$ is an element, but that element isn't a descendant of the [select](#) element on which the [HTMLOptionsCollection](#) is rooted, then throw a "[NotFoundError](#)" [DOMException](#).
3. If $element$ and $before$ are the same element, then return.

4. If *before* is a node, then let *reference* be that node. Otherwise, if *before* is an integer, and there is a *beforeth* node in the collection, let *reference* be that node. Otherwise, let *reference* be null.
5. If *reference* is not null, let *parent* be the parent node of *reference*. Otherwise, let *parent* be the [select](#) element on which the [HTMLOptionsCollection](#) is rooted.
6. [Pre-insert](#) element into *parent* node before *reference*.

The *remove(index)* method must act according to the following algorithm:

1. If the number of nodes [represented by the collection](#) is zero, return.
2. If *index* is not a number greater than or equal to 0 and less than the number of nodes [represented by the collection](#), return.
3. Let *element* be the *indexth* element in the collection.
4. Remove *element* from its parent node.

The *selectedIndex* IDL attribute must act like the identically named attribute on the [select](#) element on which the [HTMLOptionsCollection](#) is rooted

2.6.3 The [DOMStringList](#) interface



[DOMStringList](#)

Support in all current engines.

Firefox 1+ Safari 5.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The [DOMStringList](#) interface is a non-fashionable retro way of representing a list of strings.

```
[Exposed=(Window,Worker)]
interface DOMStringList {
  readonly attribute unsigned long length;
  getter DOMString? item(unsigned long index);
  boolean contains(DOMString string);
};
```

New APIs must use `sequence<DOMString>` or equivalent rather than [DOMStringList](#).

`strings.length`

Returns the number of strings in `strings`.

`strings[index]`

`strings.item(index)`

Returns the string with index `index` from `strings`.

`strings.contains(string)`

Returns true if `strings` contains `string`, and false otherwise.

Each [DOMStringList](#) object has an associated [list](#).

The [DOMStringList](#) interface [supports indexed properties](#). The [supported property indices](#) are the [indices](#) of [this](#)'s associated list.

The `length` getter steps are to return [this](#)'s associated list's [size](#).

The `item(index)` method steps are to return the `index`th item in [this](#)'s associated list, or null if `index` plus one is greater than [this](#)'s associated list's [size](#).

The `contains(string)` method steps are to return true if [this](#)'s associated list [contains](#) `string`, and false otherwise.

2.7 Safe passing of structured data

To support passing JavaScript objects, including [platform objects](#), across [realm](#) boundaries, this specification defines the following infrastructure for serializing and deserializing objects, including in some cases transferring the underlying data instead of copying it. Collectively this serialization/deserialization process is known as "structured cloning", although most APIs perform separate serialization and deserialization steps. (With the notable exception being the [structuredClone\(\)](#) method.)

This section uses the terminology and typographic conventions from the JavaScript specification. [\[JAVASCRIPT\]](#)

2.7.1 *Serializable objects*

[Serializable objects](#) support being serialized, and later deserialized, in a way that is independent of any given [JavaScript Realm](#). This allows them to be stored on disk and later restored, or cloned across [agent](#) and even [agent cluster](#) boundaries.

Not all objects are [serializable objects](#), and not all aspects of objects that are [serializable objects](#) are necessarily preserved when they are serialized.

[Platform objects](#) can be [serializable objects](#) if their [primary interface](#) is decorated with the [\[Serializable\]](#) IDL [extended attribute](#). Such interfaces must also define the following algorithms:

serialization steps, taking a [platform object](#) *value*, a [Record](#) *serialized*, and a boolean *forStorage*

A set of steps that serializes the data in *value* into fields of *serialized*. The resulting data *serialized* into *serialized* must be independent of any [JavaScript Realm](#).

These steps may throw an exception if serialization is not possible.

These steps may perform a [sub-serialization](#) to serialize nested data structures. They should not call [StructuredSerialize](#) directly, as doing so will omit the important *memory* argument.

The introduction of these steps should omit mention of the *forStorage* argument if it is not relevant to the algorithm.

deserialization steps, taking a [Record](#) *serialized* and a [platform object](#) *value*

A set of steps that deserializes the data in *serialized*, using it to set up *value* as appropriate. *value* will be a newly-created instance of the [platform object](#) type in question, with none of its internal data set up; setting that up is the job of these steps.

These steps may throw an exception if deserialization is not possible.

These steps may perform a [sub-deserialization](#) to deserialize nested data structures. They should not call [StructuredDeserialize](#) directly, as doing so will omit the important *targetRealm* and *memory* arguments.

It is up to the definition of individual platform objects to determine what data is serialized and deserialized by these steps. Typically the steps are very symmetric.

The [\[Serializable\]](#) extended attribute must take no arguments, and must only appear on an interface. It must not appear more than once on an interface.

For a given [platform object](#), only the object's [primary interface](#) is considered during the (de)serialization process. Thus, if inheritance is involved in defining the interface, each [\[Serializable\]](#)-annotated interface in the inheritance chain needs to define standalone [serialization steps](#) and [deserialization steps](#), including taking into account any important data that might come from inherited interfaces.

Let's say we were defining a platform object **Person**, which had associated with it two pieces of associated data:

- a name value, which is a string;
- and a best friend value, which is either another **Person** instance or null

We could then define **Person** instances to be [serializable objects](#) by annotating the **Person**

interface with the [\[Serializable\] extended attribute](#), and defining the following accompanying algorithms:

[serialization steps](#)

1. Set *serialized*. $[[\text{Name}]]$ to *value*'s associated name value.
2. Let *serializedBestFriend* be the [sub-serialization](#) of *value*'s associated best friend value.
3. Set *serialized*. $[[\text{BestFriend}]]$ to *serializedBestFriend*.

[deserialization steps](#)

1. Set *value*'s associated name value to *serialized*. $[[\text{Name}]]$.
2. Let *deserializedBestFriend* be the [sub-deserialization](#) of *serialized*. $[[\text{BestFriend}]]$.
3. Set *value*'s associated best friend value to *deserializedBestFriend*.

Objects defined in the JavaScript specification are handled by the [StructuredSerialize](#) abstract operation directly.

Originally, this specification defined the concept of "cloneable objects", which could be cloned from one [JavaScript Realm](#) to another. However, to better specify the behavior of certain more complex situations, the model was updated to make the serialization and deserialization explicit.

2.7.2 *Transferable objects*

[Transferable objects](#) support being transferred across [agents](#). Transferring is effectively recreating the object while sharing a reference to the underlying data and then detaching the object being transferred. This is useful to transfer ownership of expensive resources. Not all objects are [transferable objects](#) and not all aspects of objects that are [transferable objects](#) are necessarily preserved when transferred.

Transferring is an irreversible and non-idempotent operation. Once an object has been transferred, it cannot be transferred, or indeed used, again.

[Platform objects](#) can be [transferable objects](#) if their [primary interface](#) is decorated with the [\[Transferable\]](#) IDL [extended attribute](#). Such interfaces must also define the following algorithms:

transfer steps, taking a [platform object](#) *value* and a [Record](#) *dataHolder*

A set of steps that transfers the data in *value* into fields of *dataHolder*. The resulting data held in *dataHolder* must be independent of any [JavaScript Realm](#).

These steps may throw an exception if transferral is not possible.

transfer-receiving steps, taking a [Record](#) *dataHolder* and a [platform object](#) *value*

A set of steps that receives the data in *dataHolder*, using it to set up *value* as appropriate. *value* will be a newly-created instance of the [platform object](#) type in question, with none of its internal data set up; setting that up is the job of these steps.

These steps may throw an exception if it is not possible to receive the transfer.

It is up to the definition of individual platform objects to determine what data is transferred by these steps. Typically the steps are very symmetric.

The [\[Transferable\]](#) extended attribute must take no arguments, and must only appear on an interface. It must not appear more than once on an interface.

For a given [platform object](#), only the object's [primary interface](#) is considered during the transferring process. Thus, if inheritance is involved in defining the interface, each [\[Transferable\]](#)-annotated interface in the inheritance chain needs to define standalone [transfer steps](#) and [transfer-receiving steps](#), including taking into account any important data that might come from inherited interfaces.

[Platform objects](#) that are [transferable objects](#) have a [\[\[Detached\]\]](#) internal slot. This is used to ensure that once a platform object has been transferred, it cannot be transferred again.

Objects defined in the JavaScript specification are handled by the [StructuredSerializeWithTransfer](#) abstract operation directly.

2.7.3 *StructuredSerializeInternal(value, forStorage[, memory])*

The [StructuredSerializeInternal](#) abstract operation takes as input a JavaScript value *value* and serializes it to a [Realm](#)-independent form, represented here as a [Record](#). This serialized form has all the information necessary to later deserialize into a new JavaScript value in a different Realm.

This process can throw an exception, for example when trying to serialize un-serializable objects.

1. If *memory* was not supplied, let *memory* be an empty [map](#).

The purpose of the *memory* map is to avoid serializing objects twice. This ends up preserving cycles and the identity of duplicate objects in graphs.

2. If *memory*[*value*] [exists](#), then return *memory*[*value*].
3. Let *deep* be false.
4. If [Type](#)(*value*) is Undefined, Null, Boolean, Number, BigInt, or String, then return {

- `[[Type]]: "primitive", [[Value]]: value }.`
5. If [Type](#)(*value*) is Symbol, then throw a ["DataCloneError" DOMException](#).
 6. Let *serialized* be an uninitialized value.
 7. If *value* has a `[[BooleanData]]` internal slot, then set *serialized* to `{ [[Type]]: "Boolean", [[BooleanData]]: value.[[BooleanData]] }`.
 8. Otherwise, if *value* has a `[[NumberData]]` internal slot, then set *serialized* to `{ [[Type]]: "Number", [[NumberData]]: value.[[NumberData]] }`.
 9. Otherwise, if *value* has a `[[BigIntData]]` internal slot, then set *serialized* to `{ [[Type]]: "BigInt", [[BigIntData]]: value.[[BigIntData]] }`.
 10. Otherwise, if *value* has a `[[StringData]]` internal slot, then set *serialized* to `{ [[Type]]: "String", [[StringData]]: value.[[StringData]] }`.
 11. Otherwise, if *value* has a `[[DateValue]]` internal slot, then set *serialized* to `{ [[Type]]: "Date", [[DateValue]]: value.[[DateValue]] }`.
 12. Otherwise, if *value* has a `[[RegExpMatcher]]` internal slot, then set *serialized* to `{ [[Type]]: "RegExp", [[RegExpMatcher]]: value.[[RegExpMatcher]], [[OriginalSource]]: value.[[OriginalSource]], [[OriginalFlags]]: value.[[OriginalFlags]] }`.
 13. Otherwise, if *value* has an `[[ArrayBufferData]]` internal slot, then:
 1. Let *size* be *value*.`[[ArrayBufferByteLength]]`.
 2. If ! [IsSharedArrayBuffer](#)(*value*) is true, then:
 1. If the [current settings object's cross-origin isolated capability](#) is false, then throw a ["DataCloneError" DOMException](#).

This check is only needed when serializing (and not when deserializing) as the [cross-origin isolated capability](#) cannot change over time and a [SharedArrayBuffer](#) cannot leave an [agent cluster](#).

 2. If *forStorage* is true, then throw a ["DataCloneError" DOMException](#).
 3. Set *serialized* to `{ [[Type]]: "SharedArrayBuffer", [[ArrayBufferData]]: value.[[ArrayBufferData]], [[ArrayBufferByteLength]]: size, [[AgentCluster]]: the surrounding agent's agent cluster }`.
 3. Otherwise:
 1. If ! [IsDetachedBuffer](#)(*value*) is true, then throw a ["DataCloneError" DOMException](#).

2. Let *dataCopy* be ? [CreateByteDataBlock](#)(*size*).

This can throw a [RangeError](#) exception upon allocation failure.

3. Perform ! [CopyDataBlockBytes](#)(*dataCopy*, 0, *value*.[[ArrayBufferData]], 0, *size*).
4. Set *serialized* to { [[Type]]: "ArrayBuffer", [[ArrayBufferData]]: *dataCopy*, [[ArrayBufferByteLength]]: *size* }.

14. Otherwise, if *value* has a [[ViewedArrayBuffer]] internal slot, then:

1. Let *buffer* be the value of *value*'s [[ViewedArrayBuffer]] internal slot.
2. Let *bufferSerialized* be ? [StructuredSerializeInternal](#)(*buffer*, *forStorage*, *memory*).
3. Assert: *bufferSerialized*.[[Type]] is "ArrayBuffer" or "SharedArrayBuffer".
4. If *value* has a [[DataView]] internal slot, then set *serialized* to { [[Type]]: "ArrayBufferView", [[Constructor]]: "DataView", [[ArrayBufferSerialized]]: *bufferSerialized*, [[ByteLength]]: *value*.[[ByteLength]], [[ByteOffset]]: *value*.[[ByteOffset]] }.
5. Otherwise:
 1. Assert: *value* has a [[TypedArrayName]] internal slot.
 2. Set *serialized* to { [[Type]]: "ArrayBufferView", [[Constructor]]: *value*.[[TypedArrayName]], [[ArrayBufferSerialized]]: *bufferSerialized*, [[ByteLength]]: *value*.[[ByteLength]], [[ByteOffset]]: *value*.[[ByteOffset]], [[ArrayLength]]: *value*.[[ArrayLength]] }.

15. Otherwise, if *value* has [[MapData]] internal slot, then:

1. Set *serialized* to { [[Type]]: "Map", [[MapData]]: a new empty [List](#) }.
2. Set *deep* to true.

16. Otherwise, if *value* has [[SetData]] internal slot, then:

1. Set *serialized* to { [[Type]]: "Set", [[SetData]]: a new empty [List](#) }.
2. Set *deep* to true.

17. Otherwise, if *value* has an [[ErrorData]] internal slot and *value* is not a [platform object](#), then:

1. Let *name* be ? [Get](#)(*value*, "name").
2. If *name* is not one of "Error", "EvalError", "RangeError", "ReferenceError", "SyntaxError", "TypeError", or "URIError", then set *name* to "Error".
3. Let *valueMessageDesc* be ? *value*.[[GetOwnProperty]]("message").
4. Let *message* be undefined if [IsDataDescriptor](#)(*valueMessageDesc*) is false, and ? [ToString](#)(*valueMessageDesc*.[[Value]]) otherwise.
5. Set *serialized* to { [[Type]]: "Error", [[Name]]: *name*, [[Message]]: *message* }.
6. User agents should attach a serialized representation of any interesting accompanying data which are not yet specified, notably the **stack** property, to *serialized*.

See the *Error Stacks* proposal for in-progress work on specifying this data.
[\[JSERRORSTACKS\]](#)

18. Otherwise, if *value* is an Array exotic object, then:

1. Let *valueLenDescriptor* be ? [OrdinaryGetOwnProperty](#)(*value*, "length").
2. Let *valueLen* be *valueLenDescriptor*.[[Value]].
3. Set *serialized* to { [[Type]]: "Array", [[Length]]: *valueLen*, [[Properties]]: a new empty [List](#) }.
4. Set *deep* to true.

19. Otherwise, if *value* is a [platform object](#) that is a [serializable object](#):

1. If *value* has a [\[\[Detached\]\]](#) internal slot whose value is true, then throw a "[DataCloneError](#)" [DOMException](#).
2. Let *typeString* be the identifier of the [primary interface](#) of *value*.
3. Set *serialized* to { [[Type]]: *typeString* }.
4. Set *deep* to true.

20. Otherwise, if *value* is a [platform object](#), then throw a "[DataCloneError](#)" [DOMException](#).

21. Otherwise, if [IsCallable](#)(*value*) is true, then throw a "[DataCloneError](#)" [DOMException](#).

22. Otherwise, if *value* has any internal slot other than [[Prototype]] or [[Extensible]], then

throw a "[DataCloneError](#)" [DOMException](#).

For instance, a [[PromiseState]] or [[WeakMapData]] internal slot.

23. Otherwise, if *value* is an exotic object and *value* is not the [%Object.prototype%](#) intrinsic object associated with any [JavaScript realm](#), then throw a "[DataCloneError](#)" [DOMException](#).

For instance, a proxy object.

24. Otherwise:

1. Set *serialized* to { [[Type]]: "Object", [[Properties]]: a new empty [List](#) }.
2. Set *deep* to true.

[%Object.prototype%](#) will end up being handled via this step and subsequent steps. The end result is that its exoticness is ignored, and after deserialization the result will be an empty object (not an [immutable prototype exotic object](#)).

25. [Set](#) *memory*[*value*] to *serialized*.

26. If *deep* is true, then:

1. If *value* has a [[MapData]] internal slot, then:
 1. Let *copiedList* be a new empty [List](#).
 2. [For each Record](#) { [[Key]], [[Value]] } *entry* of *value*.[[MapData]]:
 1. Let *copiedEntry* be a new [Record](#) { [[Key]]: *entry*.[[Key]], [[Value]]: *entry*.[[Value]] }.
 2. If *copiedEntry*.[[Key]] is not the special value *empty*, [append](#) *copiedEntry* to *copiedList*.
 3. [For each Record](#) { [[Key]], [[Value]] } *entry* of *copiedList*:
 1. Let *serializedKey* be ? [StructuredSerializeInternal](#)(*entry*.[[Key]], *forStorage*, *memory*).
 2. Let *serializedValue* be ? [StructuredSerializeInternal](#)(*entry*.[[Value]], *forStorage*, *memory*).
 3. [Append](#) { [[Key]]: *serializedKey*, [[Value]]: *serializedValue* } to *serialized*.[[MapData]].
2. Otherwise, if *value* has a [[SetData]] internal slot, then:

1. Let *copiedList* be a new empty [List](#).
2. [For each](#) entry of *value*.[[SetData]]:
 1. If *entry* is not the special value *empty*, [append](#) *entry* to *copiedList*.
 3. [For each](#) entry of *copiedList*:
 1. Let *serializedEntry* be ? [StructuredSerializeInternal](#)(*entry*, *forStorage*, *memory*).
 2. [Append](#) *serializedEntry* to *serialized*.[[SetData]].
3. Otherwise, if *value* is a [platform object](#) that is a [serializable object](#), then perform the [serialization steps](#) for *value*'s [primary interface](#), given *value*, *serialized*, and *forStorage*.

The [serialization steps](#) may need to perform a *sub-serialization*. This is an operation which takes as input a value *subValue*, and returns [StructuredSerializeInternal](#)(*subValue*, *forStorage*, *memory*). (In other words, a [sub-serialization](#) is a specialization of [StructuredSerializeInternal](#) to be consistent within this invocation.)

4. Otherwise, for each *key* in ! [EnumerableOwnPropertyNames](#)(*value*, *key*):
 1. If ! [HasOwnProperty](#)(*value*, *key*) is true, then:
 1. Let *inputValue* be ? *value*.[[Get]](*key*, *value*).
 2. Let *outputValue* be ? [StructuredSerializeInternal](#)(*inputValue*, *forStorage*, *memory*).
 3. [Append](#) { [[Key]]: *key*, [[Value]]: *outputValue* } to *serialized*.[[Properties]].

27. Return *serialized*.

It's important to realize that the [Records](#) produced by [StructuredSerializeInternal](#) might contain "pointers" to other records that create circular references. For example, when we pass the following JavaScript object into [StructuredSerializeInternal](#):

```
const o = {};
o.myself = o;
```

it produces the following result:

{

```

[[Type]]: "Object",
[[Properties]]: «
{
  [[Key]]: "myself",
  [[Value]]: <a pointer to this whole structure>
}
»
}

```

2.7.4 *StructuredSerialize*(*value*)

1. Return ? [StructuredSerializeInternal](#)(*value*, false).

2.7.5 *StructuredSerializeForStorage*(*value*)

1. Return ? [StructuredSerializeInternal](#)(*value*, true).

2.7.6 *StructuredDeserialize*(*serialized*, *targetRealm* [, *memory*])

The [StructuredDeserialize](#) abstract operation takes as input a [Record](#) *serialized*, which was previously produced by [StructuredSerialize](#) or [StructuredSerializeForStorage](#), and deserializes it into a new JavaScript value, created in *targetRealm*.

This process can throw an exception, for example when trying to allocate memory for the new objects (especially [ArrayBuffer](#) objects).

1. If *memory* was not supplied, let *memory* be an empty [map](#).

The purpose of the *memory* map is to avoid deserializing objects twice. This ends up preserving cycles and the identity of duplicate objects in graphs.

2. If *memory*[*serialized*] [exists](#), then return *memory*[*serialized*].
3. Let *deep* be false.
4. Let *value* be an uninitialized value.
5. If *serialized*.[[Type]] is "primitive", then set *value* to *serialized*.[[Value]].
6. Otherwise, if *serialized*.[[Type]] is "Boolean", then set *value* to a new Boolean object in *targetRealm* whose [[BooleanData]] internal slot value is *serialized*.[[BooleanData]].
7. Otherwise, if *serialized*.[[Type]] is "Number", then set *value* to a new Number object in *targetRealm* whose [[NumberData]] internal slot value is *serialized*.[[NumberData]].
8. Otherwise, if *serialized*.[[Type]] is "BigInt", then set *value* to a new BigInt object in *targetRealm* whose [[BigIntData]] internal slot value is *serialized*.[[BigIntData]].

9. Otherwise, if *serialized*.[[Type]] is "String", then set *value* to a new String object in *targetRealm* whose [[StringData]] internal slot value is *serialized*.[[StringData]].
10. Otherwise, if *serialized*.[[Type]] is "Date", then set *value* to a new Date object in *targetRealm* whose [[DateValue]] internal slot value is *serialized*.[[DateValue]].
11. Otherwise, if *serialized*.[[Type]] is "RegExp", then set *value* to a new RegExp object in *targetRealm* whose [[RegExpMatcher]] internal slot value is *serialized*.[[RegExpMatcher]], whose [[OriginalSource]] internal slot value is *serialized*.[[OriginalSource]], and whose [[OriginalFlags]] internal slot value is *serialized*.[[OriginalFlags]].
12. Otherwise, if *serialized*.[[Type]] is "SharedArrayBuffer", then:
 1. If *targetRealm*'s corresponding [agent cluster](#) is not *serialized*.[[AgentCluster]], then then throw a ["DataCloneError" DOMException](#).
 2. Otherwise, set *value* to a new SharedArrayBuffer object in *targetRealm* whose [[ArrayBufferData]] internal slot value is *serialized*.[[ArrayBufferData]] and whose [[ArrayBufferByteLength]] internal slot value is *serialized*.[[ArrayBufferByteLength]].
13. Otherwise, if *serialized*.[[Type]] is "ArrayBuffer", then set *value* to a new ArrayBuffer object in *targetRealm* whose [[ArrayBufferData]] internal slot value is *serialized*.[[ArrayBufferData]], and whose [[ArrayBufferByteLength]] internal slot value is *serialized*.[[ArrayBufferByteLength]].

If this throws an exception, catch it, and then throw a ["DataCloneError" DOMException](#).

This step might throw an exception if there is not enough memory available to create such an ArrayBuffer object.

14. Otherwise, if *serialized*.[[Type]] is "ArrayBufferView", then:
 1. Let *deserializedArrayBuffer* be ?
 [StructuredDeserialize\(*serialized*.\[\[ArrayBufferSerialized\]\], *targetRealm*, *memory*\).](#)
 2. If *serialized*.[[Constructor]] is "DataView", then set *value* to a new DataView object in *targetRealm* whose [[ViewedArrayBuffer]] internal slot value is *deserializedArrayBuffer*, whose [[ByteLength]] internal slot value is *serialized*.[[ByteLength]], and whose [[ByteOffset]] internal slot value is *serialized*.[[ByteOffset]].
 3. Otherwise, set *value* to a new typed array object in *targetRealm*, using the constructor given by *serialized*.[[Constructor]], whose [[ViewedArrayBuffer]] internal slot value is *deserializedArrayBuffer*, whose [[TypedArrayName]]

internal slot value is *serialized*.***[[Constructor]]***, whose ***[[ByteLength]]*** internal slot value is *serialized*.***[[ByteLength]]***, whose ***[[ByteOffset]]*** internal slot value is *serialized*.***[[ByteOffset]]***, and whose ***[[ArrayLength]]*** internal slot value is *serialized*.***[[ArrayLength]]***.

15. Otherwise, if *serialized*.***[[Type]]*** is "Map", then:

1. Set *value* to a new Map object in *targetRealm* whose ***[[MapData]]*** internal slot value is a new empty [List](#).
2. Set *deep* to true.

16. Otherwise, if *serialized*.***[[Type]]*** is "Set", then:

1. Set *value* to a new Set object in *targetRealm* whose ***[[SetData]]*** internal slot value is a new empty [List](#).
2. Set *deep* to true.

17. Otherwise, if *serialized*.***[[Type]]*** is "Array", then:

1. Let *outputProto* be *targetRealm*.***[[Intrinsics]]***.[***\[%Array.prototype%\]***](#).
2. Set *value* to ! [ArrayCreate](#)(*serialized*.***[[Length]]***, *outputProto*).
3. Set *deep* to true.

18. Otherwise, if *serialized*.***[[Type]]*** is "Object", then:

1. Set *value* to a new Object in *targetRealm*.
2. Set *deep* to true.

19. Otherwise, if *serialized*.***[[Type]]*** is "Error", then:

1. Let *prototype* be [***%Error.prototype%***](#).
2. If *serialized*.***[[Name]]*** is "EvalError", then set *prototype* to [***%EvalError.prototype%***](#).
3. If *serialized*.***[[Name]]*** is "RangeError", then set *prototype* to [***%RangeError.prototype%***](#).
4. If *serialized*.***[[Name]]*** is "ReferenceError", then set *prototype* to [***%ReferenceError.prototype%***](#).
5. If *serialized*.***[[Name]]*** is "SyntaxError", then set *prototype* to [***%SyntaxError.prototype%***](#).

6. If *serialized*.[[Name]] is "TypeError", then set *prototype* to [%TypeError.prototype%](#).
 7. If *serialized*.[[Name]] is "URIError", then set *prototype* to [%URIError.prototype%](#).
 8. Let *message* be *serialized*.[[Message]].
 9. Set *value* to ! [ObjectCreate](#)(*prototype*, « [[ErrorData]] »).
 10. Let *messageDesc* be [PropertyDescriptor](#){ [[Value]]: *message*, [[Writable]]: true, [[Enumerable]]: false, [[Configurable]]: true }.
 11. If *message* is not undefined, then perform ! [OrdinaryDefineOwnProperty](#)(*value*, "message", *messageDesc*).
 12. Any interesting accompanying data attached to *serialized* should be deserialized and attached to *value*.
20. Otherwise:
1. Let *interfaceName* be *serialized*.[[Type]].
 2. If the interface identified by *interfaceName* is not [exposed](#) in *targetRealm*, then throw a ["DataCloneError" DOMException](#).
 3. Set *value* to a new instance of the interface identified by *interfaceName*, created in *targetRealm*.
 4. Set *deep* to true.
21. [Set](#) *memory*[*serialized*] to *value*.
22. If *deep* is true, then:
1. If *serialized*.[[Type]] is "Map", then:
 1. [For each Record](#) { [[Key]], [[Value]] } *entry* of *serialized*.[[MapData]]:
 1. Let *deserializedKey* be ? [StructuredDeserialize](#)(*entry*.[[Key]], *targetRealm*, *memory*).
 2. Let *deserializedValue* be ? [StructuredDeserialize](#)(*entry*.[[Value]], *targetRealm*, *memory*).
 3. [Append](#) { [[Key]]: *deserializedKey*, [[Value]]: *deserializedValue* } to *value*.[[MapData]].

2. Otherwise, if *serialized*.[[Type]] is "Set", then:
 1. For each entry of *serialized*.[[SetData]]:
 1. Let *deserializedEntry* be ? [StructuredDeserialize](#)(*entry*, *targetRealm*, *memory*).
 2. Append *deserializedEntry* to *value*.[[SetData]].
3. Otherwise, if *serialized*.[[Type]] is "Array" or "Object", then:
 1. For each Record { [[Key]], [[Value]] } *entry* of *serialized*.[[Properties]]:
 1. Let *deserializedValue* be ? [StructuredDeserialize](#)(*entry*.[[Value]], *targetRealm*, *memory*).
 2. Let *result* be ! [CreateDataProperty](#)(*value*, *entry*.[[Key]], *deserializedValue*).
 3. Assert: *result* is true.
4. Otherwise:
 1. Perform the appropriate [deserialization steps](#) for the interface identified by *serialized*.[[Type]], given *serialized* and *value*.

The [deserialization steps](#) may need to perform a *sub-deserialization*. This is an operation which takes as input a previously-serialized [Record subSerialized](#), and returns [StructuredDeserialize](#)(*subSerialized*, *targetRealm*, *memory*). (In other words, a [sub-deserialization](#) is a specialization of [StructuredDeserialize](#) to be consistent within this invocation.)

23. Return *value*.

2.7.7 StructuredSerializeWithTransfer(*value*, *transferList*)

1. Let *memory* be an empty [map](#).

In addition to how it is used normally by [StructuredSerializeInternal](#), in this algorithm *memory* is also used to ensure that [StructuredSerializeInternal](#) ignores items in *transferList*, and let us do our own handling instead.

2. For each *transferable* of *transferList*:

1. If *transferable* has neither an [[ArrayBufferData]] internal slot nor a [[Detached]] internal slot, then throw a ["DataCloneError" DOMException](#).

2. If *transferable* has an `[[ArrayBufferData]]` internal slot and ! `IsSharedArrayBuffer(transferable)` is true, then throw a [`"DataCloneError"` `DOMException`](#).
 3. If *memory[transferable]* exists, then throw a [`"DataCloneError"` `DOMException`](#).
 4. Set *memory[transferable]* to { `[[Type]]`: an uninitialized value }.
- transferable* is not transferred yet as transferring has side effects and `StructuredSerializeInternal` needs to be able to throw first.
3. Let *serialized* be ? [`StructuredSerializeInternal`\(*value*, false, *memory*\)](#).
 4. Let *transferDataHolders* be a new empty [`List`](#).
 5. For each *transferable* of *transferList*:
 1. If *transferable* has an `[[ArrayBufferData]]` internal slot and ! `IsDetachedBuffer(transferable)` is true, then throw a [`"DataCloneError"` `DOMException`](#).
 2. If *transferable* has a `[[Detached]]` internal slot and *transferable.[[Detached]]* is true, then throw a [`"DataCloneError"` `DOMException`](#).
 3. Let *dataHolder* be *memory[transferable]*.
 4. If *transferable* has an `[[ArrayBufferData]]` internal slot, then:
 1. Set *dataHolder.[[Type]]* to "ArrayBuffer".
 2. Set *dataHolder.[[ArrayBufferData]]* to *transferable.[[ArrayBufferData]]*.
 3. Set *dataHolder.[[ArrayBufferByteLength]]* to *transferable.[[ArrayBufferByteLength]]*.
 4. Perform ? [`Detach ArrayBuffer`\(*transferable*\)](#).

Specifications can use the `[[ArrayBufferDetachKey]]` internal slot to prevent [`ArrayBuffers`](#) from being detached. This is used in [*WebAssembly JavaScript Interface*](#), for example. [`\[WASMJS\]`](#)
 5. Otherwise:
 1. Assert: *transferable* is a [`platform object`](#) that is a [`transferable object`](#).
 2. Let *interfaceName* be the identifier of the [`primary interface`](#) of *transferable*.

3. Set *dataHolder*.[[Type]] to *interfaceName*.
 4. Perform the appropriate [transfer steps](#) for the interface identified by *interfaceName*, given *transferable* and *dataHolder*.
 5. Set *transferable*.[[Detached]] to true.
 6. [Append](#) *dataHolder* to *transferDataHolders*.
6. Return { [[Serialized]]: *serialized*, [[TransferDataHolders]]: *transferDataHolders* }.

2.7.8 *StructuredDeserializeWithTransfer* (*serializeWithTransferResult*, *targetRealm*)

1. Let *memory* be an empty [map](#).

Analogous to [StructuredSerializeWithTransfer](#), in addition to how it is used normally by [StructuredDeserialize](#), in this algorithm *memory* is also used to ensure that [StructuredDeserialize](#) ignores items in *serializeWithTransferResult*.[[TransferDataHolders]], and let us do our own handling instead.

2. Let *transferredValues* be a new empty [List](#).
3. [For each](#) *transferDataHolder* of *serializeWithTransferResult*.[[TransferDataHolders]]:
 1. Let *value* be an uninitialized value.
 2. If *transferDataHolder*.[[Type]] is "ArrayBuffer", then set *value* to a new ArrayBuffer object in *targetRealm* whose [[ArrayBufferData]] internal slot value is *transferDataHolder*.[[ArrayBufferData]], and whose [[ArrayBufferByteLength]] internal slot value is *transferDataHolder*.[[ArrayBufferByteLength]].

In cases where the original memory occupied by [[ArrayBufferData]] is accessible during the deserialization, this step is unlikely to throw an exception, as no new memory needs to be allocated: the memory occupied by [[ArrayBufferData]] is instead just getting transferred into the new ArrayBuffer. This could be true, for example, when both the source and target Realms are in the same process.

3. Otherwise:
 1. Let *interfaceName* be *transferDataHolder*.[[Type]].
 2. If the interface identified by *interfaceName* is not exposed in *targetRealm*, then throw a ["DataCloneError" DOMException](#).
 3. Set *value* to a new instance of the interface identified by *interfaceName*,

created in *targetRealm*.

4. Perform the appropriate [transfer-receiving steps](#) for the interface identified by *interfaceName* given *transferDataHolder* and *value*.
4. [Set](#) *memory*[*transferDataHolder*] to *value*.
5. [Append](#) *value* to *transferredValues*.
4. Let *deserialized* be ? [StructuredDeserialize](#)(*serializeWithTransferResult*.[[Serialized]], *targetRealm*, *memory*).
5. Return { [[Deserialized]]: *deserialized*, [[TransferredValues]]: *transferredValues* }.

2.7.9 Performing serialization and transferring from other specifications

Other specifications may use the abstract operations defined here. The following provides some guidance on when each abstract operation is typically useful, with examples.

[StructuredSerializeWithTransfer](#)

[StructuredDeserializeWithTransfer](#)

Cloning a value to another [JavaScript Realm](#), with a transfer list, but where the target Realm is not known ahead of time. In this case the serialization step can be performed immediately, with the deserialization step delayed until the target Realm becomes known.

[messagePort.postMessage\(\)](#) uses this pair of abstract operations, as the destination Realm is not known until the [MessagePort has been shipped](#).

[StructuredSerialize](#)

[StructuredSerializeForStorage](#)

[StructuredDeserialize](#)

Creating a [JavaScript Realm](#)-independent snapshot of a given value which can be saved for an indefinite amount of time, and then reified back into a JavaScript value later, possibly multiple times.

[StructuredSerializeForStorage](#) can be used for situations where the serialization is anticipated to be stored in a persistent manner, instead of passed between Realms. It throws when attempting to serialize [SharedArrayBuffer](#) objects, since storing shared memory does not make sense. Similarly, it can throw or possibly have different behavior when given a [platform object](#) with custom [serialization steps](#) when the *forStorage* argument is true.

[history.pushState\(\)](#) and [history.replaceState\(\)](#) use [StructuredSerializeForStorage](#) on author-supplied state objects, storing them as [serialized state](#) in the appropriate [session history entry](#). Then, [StructuredDeserialize](#) is used so that

the [history.state](#) property can return a clone of the originally-supplied state object.

[broadcastChannel.postMessage\(\)](#) uses [StructuredSerialize](#) on its input, then uses [StructuredDeserialize](#) multiple times on the result to produce a fresh clone for each destination being broadcast to. Note that transferring does not make sense in multi-destination situations.

Any API for persisting JavaScript values to the filesystem would also use [StructuredSerializeForStorage](#) on its input and [StructuredDeserialize](#) on its output.

In general, call sites may pass in Web IDL values instead of JavaScript values; this is to be understood to perform an implicit [conversion](#) to the JavaScript value before invoking these algorithms.

Call sites that are not invoked as a result of author code synchronously calling into a user agent method must take care to properly [prepare to run script](#) and [prepare to run a callback](#) before invoking [StructuredSerialize](#), [StructuredSerializeForStorage](#), or [StructuredSerializeWithTransfer](#) abstract operations, if they are being performed on arbitrary objects. This is necessary because the serialization process can invoke author-defined accessors as part of its final deep-serialization steps, and these accessors could call into operations that rely on the [entry](#) and [incumbent](#) concepts being properly set up.

[window.postMessage\(\)](#) performs [StructuredSerializeWithTransfer](#) on its arguments, but is careful to do so immediately, inside the synchronous portion of its algorithm. Thus it is able to use the algorithms without needing to [prepare to run script](#) and [prepare to run a callback](#).

In contrast, a hypothetical API that used [StructuredSerialize](#) to serialize some author-supplied object periodically, directly from a [task](#) on the [event loop](#), would need to ensure it performs the appropriate preparations beforehand. As of this time, we know of no such APIs on the platform; usually it is simpler to perform the serialization ahead of time, as a synchronous consequence of author code.

2.7.10 Structured cloning API

`result = self.structuredClone(value[, { transfer }])`

Takes the input value and returns a deep copy by performing the structured clone algorithm. [Transferable objects](#) listed in the [transfer](#) array are transferred, not just cloned, meaning that they are no longer usable in the input value.

Throws a ["DataCloneError" DOMException](#) if any part of the input value is not [serializable](#).

ΔMDN

[structuredClone](#)

Support in one engine only.

Firefox94+SafariNoChromeNo

OperaNoEdgeNo

Edge (Legacy)NoInternet ExplorerNo

Firefox Android94+Safari iOSNoChrome AndroidNoWebView AndroidNoSamsung

InternetNoOpera AndroidNo

The `structuredClone(value, options)` method steps are:

1. Let `serialized` be ? [StructuredSerializeWithTransfer](#)(`value, options["transfer"]`).
2. Let `deserializeRecord` be ? [StructuredDeserializeWithTransfer](#)(`serialized, this's relevant Realm`).
3. Return `deserializeRecord.[[Deserialized]]`.

3 Semantics, structure, and APIs of HTML documents

3.1 Documents

Every XML and HTML document in an HTML UA is represented by a [Document](#) object. [\[DOM\]](#)

The [Document](#) object's [URL](#) is defined in *DOM*. It is initially set when the [Document](#) object is created, but can change during the lifetime of the [Document](#) object; for example, it changes when the user [navigates](#) to a [fragment](#) on the page and when the [pushState\(\)](#) method is called with a new [URL](#). [\[DOM\]](#)

Interactive user agents typically expose the [Document](#) object's [URL](#) in their user interface. This is the primary mechanism by which a user can tell if a site is attempting to impersonate another.

The [Document](#) object's [origin](#) is defined in *DOM*. It is initially set when the [Document](#) object is created, and can change during the lifetime of the [Document](#) only upon setting [document.domain](#). A [Document](#)'s [origin](#) may differ from the [origin](#) of its [URL](#); for example when a [nested browsing context](#) is created, its [active Document](#)'s [origin](#) is set to the [nested browsing context's container document's origin](#), even though its [active Document](#)'s [URL](#) is [about:blank](#). [\[DOM\]](#)

When a [Document](#) is created by a [script](#) using the [createDocument\(\)](#) or [createHTMLDocument\(\)](#), the [Document](#) is [ready for post-load tasks](#) immediately.

The [document's referrer](#) is a string (representing a [URL](#)) that can be set when the [Document](#) is created. If it is not explicitly set, then its value is the empty string.

3.1.1 The [Document](#) object

✓MDN

[Document](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 3+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

DOM defines a [Document](#) interface, which this specification extends significantly.

```
enum DocumentReadyState { "loading", "interactive", "complete" };
enum DocumentVisibilityState { "visible", "hidden" };
typedef (HTMLScriptElement or SVGScriptElement) HTMLOrSVGScriptElement;

\[LegacyOverrideBuiltIns\]
partial interface Document {
    // resource metadata management
    \[PutForwards=href, LegacyUnforgeable\] readonly attribute Location? location;
    attribute USVString domain;
    readonly attribute USVString referrer;
    attribute USVString cookie;
    readonly attribute DOMString lastModified;
    readonly attribute DocumentReadyState readyState;

    // DOM tree accessors
    getter object (DOMString name);
    \[CEReactions\] attribute DOMString title;
    \[CEReactions\] attribute DOMString dir;
    \[CEReactions\] attribute HTMLElement? body;
    readonly attribute HTMLHeadElement? head;
    \[SameObject\] readonly attribute HTMLCollection images;
    \[SameObject\] readonly attribute HTMLCollection embeds;
    \[SameObject\] readonly attribute HTMLCollection plugins;
    \[SameObject\] readonly attribute HTMLCollection links;
    \[SameObject\] readonly attribute HTMLCollection forms;
    \[SameObject\] readonly attribute HTMLCollection scripts;
    NodeList getElementsByName(DOMString elementName);
    readonly attribute HTMLOrSVGScriptElement? currentScript; // classic script

    // dynamic markup insertion
```

```

[CEReactions] Document open(optional DOMString unused1, optional DOMString unused2);
WindowProxy? open(USVString url, DOMString name, DOMString features);
[CEReactions] undefined close();
[CEReactions] undefined write(DOMString... text);
[CEReactions] undefined writeln(DOMString... text);

// user interaction
readonly attribute WindowProxy? defaultView;
boolean hasFocus();
[CEReactions] attribute DOMString designMode;
[CEReactions] boolean execCommand(DOMString commandId, optional boolean showUI);
boolean queryCommandEnabled(DOMString commandId);
boolean queryCommandIndeterm(DOMString commandId);
boolean queryCommandState(DOMString commandId);
boolean queryCommandSupported(DOMString commandId);
DOMString queryCommandValue(DOMString commandId);
readonly attribute boolean hidden;
readonly attribute DocumentVisibilityState visibilityState;

// special event handler IDL attributes that only apply to Document objects
[LegacyLenientThis] attribute EventHandler onreadystatechange;
attribute EventHandler onvisibilitychange;

// also has obsolete members
};

Document includes GlobalEventHandlers;
Document includes DocumentAndElementEventHandlers;

```

The [Document](#) has a *policy container* (a [policy container](#)), initially a new policy container, which contains policies which apply to the [Document](#).

The [Document](#) has a *permissions policy*, which is a [permissions policy](#), which is initially empty.

The [Document](#) has a *module map*, which is a [module map](#), initially empty.

The [Document](#) has a *cross-origin opener policy*, which is a [cross-origin opener policy](#).

The [Document](#) has an *is initial about:blank*, which is a boolean, initially false. A [browsing context](#) `browsingContext` is still on its *initial about:blank Document* if `browsingContext`'s [session history](#)'s `size` is 1 and `browsingContext`'s [session history](#)[0]'s [document](#)'s *is initial about:blank* is true.

The [Document](#) has a *navigation id*, which is a [navigation id](#) or null.

3.1.2 The [DocumentOrShadowRoot](#) interface

DOM defines the [DocumentOrShadowRoot](#) mixin, which this specification extends.

```
partial interface mixin DocumentOrShadowRoot {  
  readonly attribute Element? activeElement;  
};
```

3.1.3 Resource metadata management

`document.referrer`



[Document/referrer](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 3+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns the [URL](#) of the [Document](#) from which the user navigated to this one, unless it was blocked or there was no such document, in which case it returns the empty string.

The [noreferrer](#) link type can be used to block the referrer.

The `referrer` attribute must return [the document's referrer](#).

`document.cookie [= value]`

Returns the HTTP cookies that apply to the [Document](#). If there are no cookies or cookies can't be applied to this resource, the empty string will be returned.

Can be set, to add a new cookie to the element's set of HTTP cookies.

If the contents are [sandboxed into a unique origin](#) (e.g. in an [iframe](#) with the [sandbox](#) attribute), a "[SecurityError](#)" [DOMException](#) will be thrown on getting and setting.



[Document/cookie](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 3+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet1.0+Opera Android10.1+

The `cookie` attribute represents the cookies of the resource identified by the document's [URL](#).

A [Document](#) object that falls into one of the following conditions is a *cookie-averse Document object*:

- A [Document](#) object whose [browsing context](#) is null.
- A [Document](#) whose [URL](#)'s [scheme](#) is not an [HTTP\(S\)](#) scheme.

(This

is a

tracking

[vector.](#)) On getting, if the document is a [cookie-averse Document object](#), then the user agent must return the empty string. Otherwise, if the [Document](#)'s [origin](#) is an [opaque origin](#), the user agent must throw a ["SecurityError" DOMException](#). Otherwise, the user agent must return the [cookie-string](#) for the document's [URL](#) for a "non-HTTP" API, decoded using [UTF-8 decode without BOM](#). [\[COOKIES\]](#)

On setting, if the document is a [cookie-averse Document object](#), then the user agent must do nothing. Otherwise, if the [Document](#)'s [origin](#) is an [opaque origin](#), the user agent must throw a ["SecurityError" DOMException](#). Otherwise, the user agent must act as it would when receiving a [set-cookie-string](#) for the document's [URL](#) via a "non-HTTP" API, consisting of the new value [encoded as UTF-8](#). [\[COOKIES\]](#) [\[ENCODING\]](#)

Since the `cookie` attribute is accessible across frames, the path restrictions on cookies are only a tool to help manage which cookies are sent to which parts of the site, and are not in any way a security feature.

The `cookie` attribute's getter and setter synchronously access shared state. Since there is no locking mechanism, other browsing contexts in a multiprocess user agent can modify cookies while scripts are running. A site could, for instance, try to read a cookie, increment its value, then write it back out, using the new value of the cookie as a unique identifier for the session; if the site does this twice in two different browser windows at the same time, it might end up using the same "unique" identifier for both sessions, with potentially disastrous effects.

[document.lastModified](#)



[Document/lastModified](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera12.1+Edge79+

Edge(Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns the date of the last modification to the document, as reported by the server, in the form "MM/DD/YYYY hh:mm:ss", in the user's local time zone.

If the last modification date is not known, the current time is returned instead.

The *lastModified* attribute, on getting, must return the date and time of the [Document](#)'s source file's last modification, in the user's local time zone, in the following format:

1. The month component of the date.
2. A U+002F SOLIDUS character (/).
3. The day component of the date.
4. A U+002F SOLIDUS character (/).
5. The year component of the date.
6. A U+0020 SPACE character.
7. The hours component of the time.
8. A U+003A COLON character (:).
9. The minutes component of the time.
10. A U+003A COLON character (:).
11. The seconds component of the time.

All the numeric components above, other than the year, must be given as two [ASCII digits](#) representing the number in base ten, zero-padded if necessary. The year must be given as the shortest possible string of four or more [ASCII digits](#) representing the number in base ten, zero-padded if necessary.

The [Document](#)'s source file's last modification date and time must be derived from relevant features of the networking protocols used, e.g. from the value of the HTTP '[Last-Modified](#)' header of the document, or from metadata in the file system for local files. If the last modification date and time are not known, the attribute must return the current date and time in the above format.

3.1.4 Reporting document loading status

[document.readyState](#)

Returns "**loading**" while the [Document](#) is loading, "**interactive**" once it is finished parsing but still loading subresources, and "**complete**" once it has loaded.

The [readystatechange](#) event fires on the [Document](#) object when this value changes.

The [DOMContentLoaded](#) event fires after the transition to "**interactive**" but before the transition to "**complete**", at the point where all subresources apart from [async script](#) elements have loaded.

[Document/readyState](#)

Support in all current engines.

Firefox 3.6+ Safari 1+ Chrome 1+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 11+

Each [Document](#) has a *current document readiness*, a string, initially "**complete**".

For [Document](#) objects created via the [create and initialize a Document object](#) algorithm, this will be immediately reset to "**loading**" before any script can observe the value of [document.readyState](#). This default applies to other cases such as [initial about:blank Document](#)s or [Document](#)s without a [browsing context](#).

The [readyState](#) getter steps are to return [this](#)'s [current document readiness](#).

To *update the current document readiness* for [Document](#) *document* to *readinessValue*:

1. If *document*'s [current document readiness](#) equals *readinessValue*, then return.
2. Set *document*'s [current document readiness](#) to *readinessValue*.
3. If *document* is associated with an [HTML parser](#), then:
 1. Let *now* be the [current high resolution time](#) given *document*'s [relevant global object](#).
 2. If *readinessValue* is "**complete**", and *document*'s [load timing info](#)'s [DOM complete time](#) is 0, then set *document*'s [load timing info](#)'s [DOM complete time](#) to *now*.
 3. Otherwise, if *readinessValue* is "**interactive**", and *document*'s [load timing info](#)'s [DOM interactive time](#) is 0, then set *document*'s [load timing info](#)'s [DOM interactive time](#) to *now*.
4. [Fire an event](#) named [readystatechange](#) at *document*.

A [Document](#) is said to have an *active parser* if it is associated with an [HTML parser](#) or an [XML parser](#) that has not yet been [stopped](#) or [aborted](#).

A [Document](#) has a [document load timing info](#) *load timing info*.

A [Document](#) has a [document unload timing info](#) previous document unload timing.

The *document load timing info struct* has the following [items](#):

DOM interactive time (default 0)
DOM content loaded event start time (default 0)
DOM content loaded event end time (default 0)
DOM complete time (default 0)
load event start time (default 0)
load event end time (default 0)
 [DOMHighResTimeStamp](#) values

The *document unload timing info struct* has the following [items](#):

unload event start time (default 0)
unload event end time (default 0)
 [DOMHighResTimeStamp](#) values

3.1.5 DOM tree accessors

The [html](#) element of a document is its [document element](#), if it's an [html](#) element, and null otherwise.

[document.head](#)



[Document/head](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 4+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 4+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

Returns [the head element](#).

The [head](#) element of a document is the first [head](#) element that is a child of [the html element](#), if there is one, or null otherwise.

The [head](#) attribute, on getting, must return [the head element](#) of the document (a [head](#) element or null).

`document.title [= value]`

Returns the document's title, as given by [the `title` element](#) for HTML and as given by the [SVG `title`](#) element for SVG.

Can be set, to update the document's title. If there is no appropriate element to update, the new value is ignored.

The `title` element of a document is the first `title` element in the document (in [tree order](#)), if there is one, or null otherwise.



[Document/title](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The `title` attribute must, on getting, run the following algorithm:

1. If the [document element](#) is an [SVG `svg`](#) element, then let `value` be the [child text content](#) of the first [SVG `title`](#) element that is a child of the [document element](#).
2. Otherwise, let `value` be the [child text content](#) of [the `title` element](#), or the empty string if [the `title` element](#) is null.
3. [Strip and collapse ASCII whitespace](#) in `value`.
4. Return `value`.

On setting, the steps corresponding to the first matching condition in the following list must be run:

If the [document element](#) is an [SVG `svg`](#) element

1. If there is an [SVG `title`](#) element that is a child of the [document element](#), let `element` be the first such element.
2. Otherwise:
 1. Let `element` be the result of [creating an element](#) given the [document element's node document](#), [title](#), and the [SVG namespace](#).

2. Insert *element* as the [first child](#) of the [document element](#).

3. [String replace all](#) with the given value within *element*.

If the [document element](#) is in the [HTML namespace](#)

1. If [the title element](#) is null and [the head element](#) is null, then return.
2. If [the title element](#) is non-null, let *element* be [the title element](#).
3. Otherwise:
 1. Let *element* be the result of [creating an element](#) given the [document element's node document](#), [title](#), and the [HTML namespace](#).
 2. [Append](#) *element* to [the head element](#).
4. [String replace all](#) with the given value within *element*.

Otherwise

Do nothing.

`document.body [= value]`

✓MDN

[Document/body](#)

Support in all current engines.

Firefox 60+ Safari 1+ Chrome 1+

Opera 9.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 60+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Returns [the body element](#).

Can be set, to replace [the body element](#).

If the new value is not a [body](#) or [frameset](#) element, this will throw a ["HierarchyRequestError" DOMException](#).

The *body* element of a document is the first of [the html element](#)'s children that is either a [body](#) element or a [frameset](#) element, or null if there is no such element.

The *body* attribute, on getting, must return [the body element](#) of the document (either a [body](#)

element, a [frameset](#) element, or null). On setting, the following algorithm must be run:

1. If the new value is not a [body](#) or [frameset](#) element, then throw a ["HierarchyRequestError" DOMException](#).
2. Otherwise, if the new value is the same as [the body element](#), return.
3. Otherwise, if [the body element](#) is not null, then [replace the body element](#) with the new value within [the body element's parent](#) and return.
4. Otherwise, if there is no [document element](#), throw a ["HierarchyRequestError" DOMException](#).
5. Otherwise, [the body element](#) is null, but there's a [document element](#). [Append](#) the new value to the [document element](#).

The value returned by the [body](#) getter is not always the one passed to the setter.

In this example, the setter successfully inserts a [body](#) element (though this is non-conforming since SVG does not allow a [body](#) as child of [SVG svg](#)). However the getter will return null because the document element is not [html](#).

```
<svg xmlns="http://www.w3.org/2000/svg">
<script>
  document.body = document.createElementNS("http://www.w3.org/1999/xhtml", "b
  console.assert(document.body === null);
</script>
</svg>
```

[document.images](#)



[Document/images](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns an [HTMLCollection](#) of the [img](#) elements in the [Document](#).

[document.embeds](#)



[Document/embeds](#)

Support in all current engines.

Firefox1+Safari10.1+Chrome64+

Opera51+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS10.3+Chrome Android64+WebView Android64+Samsung Internet9.0+Opera Android47+

document.plugins

✓MDN

[Document/plugins](#)

Support in all current engines.

Firefox1+Safari10.1+Chrome64+

Opera51+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS10.3+Chrome Android64+WebView Android64+Samsung Internet9.0+Opera Android47+

Returns an [HTMLCollection](#) of the [embed](#) elements in the [Document](#).

document.links

✓MDN

[Document/links](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Returns an [HTMLCollection](#) of the [a](#) and [area](#) elements in the [Document](#) that have [href](#) attributes.

document.forms

✓MDN

[Document/forms](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns an [HTMLCollection](#) of the [form](#) elements in the [Document](#).

`document.scripts`



[Document/scripts](#)

Support in all current engines.

Firefox9+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android9+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns an [HTMLCollection](#) of the [script](#) elements in the [Document](#).

The *images* attribute must return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches only [img](#) elements.

The *embeds* attribute must return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches only [embed](#) elements.

The *plugins* attribute must return the same object as that returned by the [embeds](#) attribute.

The *links* attribute must return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches only [a](#) elements with [href](#) attributes and [area](#) elements with [href](#) attributes.

The *forms* attribute must return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches only [form](#) elements.

The *scripts* attribute must return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches only [script](#) elements.

`collection = document.getElementsByName(name)`



[Document/getElementsByName](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera5+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Returns a [NodeList](#) of elements in the [Document](#) that have a `name` attribute with the value `name`.

The `getElementsByName(elementName)` method steps are to return a [live NodeList](#) containing all the [HTML elements](#) in that document that have a `name` attribute whose value is [identical to](#) the `elementName` argument, in [tree order](#). When the method is invoked on a [Document](#) object again with the same argument, the user agent may return the same as the object returned by the earlier call. In other cases, a new [NodeList](#) object must be returned.

`document.currentScript`



[Document/currentScript](#)

Support in all current engines.

Firefox4+Safari8+Chrome29+

Opera16+Edge79+

Edge (Legacy)12+Internet ExplorerNo

Firefox Android4+Safari iOS8+Chrome Android29+WebView Android37+Samsung Internet2.0+Opera Android16+

Returns the [script](#) element, or the [SVG script](#) element, that is currently executing, as long as the element represents a [classic script](#). In the case of reentrant script execution, returns the one that most recently started executing amongst those that have not yet finished executing.

Returns null if the [Document](#) is not currently executing a [script](#) or [SVG script](#) element (e.g., because the running script is an event handler, or a timeout), or if the currently executing [script](#) or [SVG script](#) element represents a [module script](#).

The `currentScript` attribute, on getting, must return the value to which it was most recently set. When the [Document](#) is created, the [currentScript](#) must be initialized to null.

This API has fallen out of favor in the implementer and standards community, as it globally exposes [script](#) or [SVG script](#) elements. As such, it is not available in newer contexts, such as when running [module scripts](#) or when running scripts in a [shadow tree](#). We are looking into creating a new solution for identifying the running script in such contexts, which does not make it globally available: see [issue #1013](#).

The [Document](#) interface [supports named properties](#). The [supported property names](#) of a [Document](#) object *document* at any moment consist of the following, in [tree order](#) according to the element that contributed them, ignoring later duplicates, and with values from [id](#) attributes coming before values from [name](#) attributes when the same element contributes both:

- the value of the [name](#) content attribute for all [exposed embed](#), [form](#), [iframe](#), [img](#), and [exposed object](#) elements that have a non-empty [name](#) content attribute and are [in a document tree](#) with *document* as their [root](#);
- the value of the [id](#) content attribute for all [exposed object](#) elements that have a non-empty [id](#) content attribute and are [in a document tree](#) with *document* as their [root](#); and
- the value of the [id](#) content attribute for all [img](#) elements that have both a non-empty [id](#) content attribute and a non-empty [name](#) content attribute, and are [in a document tree](#) with *document* as their [root](#).

To [determine the value of a named property](#) *name* for a [Document](#), the user agent must return the value obtained using the following steps:

1. Let *elements* be the list of [named elements](#) with the name *name* that are [in a document tree](#) with the [Document](#) as their [root](#).

There will be at least one such element, by definition.
2. If *elements* has only one element, and that element is an [iframe](#) element, and that [iframe](#) element's [nested browsing context](#) is not null, then return the [WindowProxy](#) object of the element's [nested browsing context](#).
3. Otherwise, if *elements* has only one element, return that element.
4. Otherwise return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches only [named elements](#) with the name *name*.

Named elements with the name *name*, for the purposes of the above algorithm, are those that are either:

- [Exposed embed](#), [form](#), [iframe](#), [img](#), or [exposed object](#) elements that have a [name](#) content attribute whose value is *name*, or
- [Exposed object](#) elements that have an [id](#) content attribute whose value is *name*, or
- [img](#) elements that have an [id](#) content attribute whose value is *name*, and that have a non-empty [name](#) content attribute present also.

An [embed](#) or [object](#) element is said to be *exposed* if it has no [exposed object](#) ancestor, and, for [object](#) elements, is additionally either not showing its [fallback content](#) or has no [object](#) or [embed](#) descendants.

The `dir` attribute on the [Document](#) interface is defined along with the `dir` content attribute.

3.2 Elements

3.2.1 Semantics

Elements, attributes, and attribute values in HTML are defined (by this specification) to have certain meanings (semantics). For example, the `ol` element represents an ordered list, and the `lang` attribute represents the language of the content.

These definitions allow HTML processors, such as web browsers or search engines, to present and use documents and applications in a wide variety of contexts that the author might not have considered.

As a simple example, consider a web page written by an author who only considered desktop computer web browsers:

```
<!DOCTYPE HTML>
<html lang="en">
  <head>
    <title>My Page</title>
  </head>
  <body>
    <h1>Welcome to my page</h1>
    <p>I like cars and lorries and have a big Jeep!</p>
    <h2>Where I live</h2>
    <p>I live in a small hut on a mountain!</p>
  </body>
</html>
```

Because HTML conveys *meaning*, rather than presentation, the same page can also be used by a small browser on a mobile phone, without any change to the page. Instead of headings being in large letters as on the desktop, for example, the browser on the mobile phone might use the same size text for the whole page, but with the headings in bold.

But it goes further than just differences in screen size: the same page could equally be used by a blind user using a browser based around speech synthesis, which instead of displaying the page on a screen, reads the page to the user, e.g. using headphones. Instead of large text for the headings, the speech browser might use a different volume or a slower voice.

That's not all, either. Since the browsers know which parts of the page are the headings, they can create a document outline that the user can use to quickly navigate around the document, using keys for "jump to next heading" or "jump to previous heading". Such features are especially common with speech browsers, where users would otherwise find quickly navigating a page quite difficult.

Even beyond browsers, software can make use of this information. Search engines can use the

headings to more effectively index a page, or to provide quick links to subsections of the page from their results. Tools can use the headings to create a table of contents (that is in fact how this very specification's table of contents is generated).

This example has focused on headings, but the same principle applies to all of the semantics in HTML.

Authors must not use elements, attributes, or attribute values for purposes other than their appropriate intended semantic purpose, as doing so prevents software from correctly processing the page.

For example, the following snippet, intended to represent the heading of a corporate site, is non-conforming because the second line is not intended to be a heading of a subsection, but merely a subheading or subtitle (a subordinate heading for the same section).

```
<body>
  <h1>ACME Corporation</h1>
  <h2>The leaders in arbitrary fast delivery since 1920</h2>
  ...

```

The [hgroup](#) element is intended for these kinds of situations:

```
<body>
  <hgroup>
    <h1>ACME Corporation</h1>
    <h2>The leaders in arbitrary fast delivery since 1920</h2>
  </hgroup>
  ...

```

The document in this next example is similarly non-conforming, despite being syntactically correct, because the data placed in the cells is clearly not tabular data, and the [cite](#) element mis-used:

```
<!DOCTYPE HTML>
<html lang="en-GB">
  <head> <title> Demonstration </title> </head>
  <body>
    <table>
      <tr> <td> My favourite animal is the cat. </td> </tr>
      <tr>
        <td>
          -<a href="https://example.org/~ernest/"><cite>Ernest</cite></a>,
          in an essay from 1992
        </td>
      </tr>
    </table>
  </body>
```

```
</html>
```

This would make software that relies on these semantics fail: for example, a speech browser that allowed a blind user to navigate tables in the document would report the quote above as a table, confusing the user; similarly, a tool that extracted titles of works from pages would extract "Ernest" as the title of a work, even though it's actually a person's name, not a title.

A corrected version of this document might be:

```
<!DOCTYPE HTML>
<html lang="en-GB">
  <head> <title> Demonstration </title> </head>
  <body>
    <blockquote>
      <p> My favourite animal is the cat. </p>
    </blockquote>
    <p>
      --<a href="https://example.org/~ernest/">Ernest</a>,
      in an essay from 1992
    </p>
  </body>
</html>
```

Authors must not use elements, attributes, or attribute values that are not permitted by this specification or [other applicable specifications](#), as doing so makes it significantly harder for the language to be extended in the future.

In the next example, there is a non-conforming attribute value ("carpet") and a non-conforming attribute ("texture"), which is not permitted by this specification:

```
<label>Carpet: <input type="carpet" name="c" texture="deep pile"></label>
```

Here would be an alternative and correct way to mark this up:

```
<label>Carpet: <input type="text" class="carpet" name="c" data-texture="deep
```

DOM nodes whose [node document](#)'s [browsing context](#) is null are exempt from all document conformance requirements other than the [HTML syntax](#) requirements and [XML syntax](#) requirements.

In particular, the [template](#) element's [template contents](#)'s [node document](#)'s [browsing context](#) is null. For example, the [content model](#) requirements and attribute value microsyntax requirements do not apply to a [template](#) element's [template contents](#). In this example an [img](#) element has attribute values that are placeholders that would be invalid outside a [template](#) element.

```
<template>
  <article>
```

```

<h1></h1>
</article>
</template>
```

However, if the above markup were to omit the `</h1>` end tag, that would be a violation of the [HTML syntax](#), and would thus be flagged as an error by conformance checkers.

Through scripting and using other mechanisms, the values of attributes, text, and indeed the entire structure of the document may change dynamically while a user agent is processing it. The semantics of a document at an instant in time are those represented by the state of the document at that instant in time, and the semantics of a document can therefore change over time. User agents must update their presentation of the document as this occurs.

HTML has a [`progress`](#) element that describes a progress bar. If its "value" attribute is dynamically updated by a script, the UA would update the rendering to show the progress changing.

3.2.2 Elements in the DOM

The nodes representing [HTML elements](#) in the DOM must implement, and expose to scripts, the interfaces listed for them in the relevant sections of this specification. This includes [HTML elements in XML documents](#), even when those documents are in another context (e.g. inside an XSLT transform).

Elements in the DOM *represent* things; that is, they have intrinsic *meaning*, also known as semantics.

For example, an [`ol`](#) element represents an ordered list.

Elements can be *referenced* (referred to) in some way, either explicitly or implicitly. One way that an element in the DOM can be explicitly referenced is by giving an [`id`](#) attribute to the element, and then creating a [hyperlink](#) with that [`id`](#) attribute's value as the [fragment](#) for the [hyperlink](#)'s [`href`](#) attribute value. Hyperlinks are not necessary for a reference, however; any manner of referring to the element in question will suffice.

Consider the following [`figure`](#) element, which is given an [`id`](#) attribute:

```
<figure id="module-script-graph">
  
  <figcaption>Figure 27: a simple module graph</figcaption>
</figure>
```

A [hyperlink](#)-based [reference](#) could be created using the [`a`](#) element, like so:

As we can see in [figure 27](#module-script-graph), ...

However, there are many other ways of [referencing](#) the [figure](#) element, such as:

- "As depicted in the figure of modules A, B, C, and D..."
- "In Figure 27..." (without a hyperlink)
- "From the contents of the 'simple module graph' figure..."
- "In the figure below..." (but [this is discouraged](#))

The basic interface, from which all the [HTML elements](#)' interfaces inherit, and which must be used by elements that have no additional requirements, is the [HTMLElement](#) interface.



[HTMLElement](#)

Support in all current engines.

Firefox 1+ Safari 1.3+ Chrome 1+

Opera 8+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

[HTMLUnknownElement](#)

Support in all current engines.

Firefox 1+ Safari 6+ Chrome 15+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

```
[Exposed=Window]
interface HTMLElement : Element {
  [HTMLConstructor] constructor();

  // metadata attributes
  [CEReactions] attribute DOMString title;
  [CEReactions] attribute DOMString lang;
  [CEReactions] attribute boolean translate;
  [CEReactions] attribute DOMString dir;
```

```

// user interaction
[CEReactions] attribute boolean hidden;
undefined click();
[CEReactions] attribute DOMString accessKey;
readonly attribute DOMString accessKeyLabel;
[CEReactions] attribute boolean draggable;
[CEReactions] attribute boolean spellcheck;
[CEReactions] attribute DOMString autocapitalize;

[CEReactions] attribute [LegacyNullToEmptyString] DOMString innerText;
[CEReactions] attribute [LegacyNullToEmptyString] DOMString outerText;

ElementInternals attachInternals();
};

HTMLElement includes GlobalEventHandlers;
HTMLElement includes DocumentAndElementEventHandlers;
HTMLElement includes ElementContentEditable;
HTMLElement includes HTMLOrSVGElement;

[Exposed=Window]
interface HTMLUnknownElement : HTMLElement {
  // Note: intentionally no [HTMLConstructor]
};

```

The [HTMLElement](#) interface holds methods and attributes related to a number of disparate features, and the members of this interface are therefore described in various different sections of this specification.

The [element](#) interface for an element with name *name* in the [HTML namespace](#) is determined as follows:

1. If *name* is [applet](#), [bgsound](#), [blink](#), [isindex](#), [keygen](#), [multicol](#), [nextid](#), or [spacer](#), then return [HTMLUnknownElement](#).
2. If *name* is [acronym](#), [basefont](#), [big](#), [center](#), [nобр](#), [noembed](#), [noframes](#), [plaintext](#), [rb](#), [rtc](#), [strike](#), or [tt](#), then return [HTMLElement](#).
3. If *name* is [listing](#) or [xmp](#), then return [HTMLPreElement](#).
4. Otherwise, if this specification defines an interface appropriate for the [element type](#) corresponding to the local name *name*, then return that interface.
5. If [other applicable specifications](#) define an appropriate interface for *name*, then return the interface they define.

6. If *name* is a [valid custom element name](#), then return [HTMLElement](#).

7. Return [HTMLUnknownElement](#).

The use of [HTMLElement](#) instead of [HTMLUnknownElement](#) in the case of [valid custom element names](#) is done to ensure that any potential future [upgrades](#) only cause a linear transition of the element's prototype chain, from [HTMLElement](#) to a subclass, instead of a lateral one, from [HTMLUnknownElement](#) to an unrelated subclass.

Features shared between HTML and SVG elements use the [HTMLOrSVGElement](#) interface mixin: [\[SVG\]](#)

```
interface mixin HTMLOrSVGElement {
  [SameObject] readonly attribute DOMStringMap dataset;
  attribute DOMString nonce; // intentionally no \[CEReactions\]

  [CEReactions] attribute boolean autofocus;
  [CEReactions] attribute long tabIndex;
  undefined focus(optional FocusOptions options = {});
  undefined blur();
};
```

An example of an element that is neither an HTML nor SVG element is one created as follows:

```
const el = document.createElementNS("some namespace", "example");
console.assert(el.constructor === Element);
```

3.2.3 HTML element constructors

To support the [custom elements](#) feature, all HTML elements have special constructor behavior. This is indicated via the [\[HTMLConstructor\]](#) IDL [extended attribute](#). It indicates that the interface object for the given interface will have a specific behavior when called, as defined in detail below.

The [\[HTMLConstructor\]](#) extended attribute must take no arguments, and must only appear on [constructor operations](#). It must appear only once on a constructor operation, and the interface must contain only the single, annotated constructor operation, and no others. The annotated constructor operation must be declared to take no arguments.

Interfaces declared with constructor operations that are annotated with the [\[HTMLConstructor\]](#) extended attribute have the following [overridden constructor steps](#):

1. Let *registry* be the [current global object](#)'s [CustomElementRegistry](#) object.
2. If *NewTarget* is equal to the [active function object](#), then throw a [TypeError](#).

This can occur when a custom element is defined using an [element interface](#) as its

constructor:

```
customElements.define("bad-1", HTMLButtonElement);
new HTMLButtonElement();           // (1)
document.createElement("bad-1");   // (2)
```

In this case, during the execution of [HTMLButtonElement](#) (either explicitly, as in (1), or implicitly, as in (2)), both the [active function object](#) and [NewTarget](#) are [HTMLButtonElement](#). If this check was not present, it would be possible to create an instance of [HTMLButtonElement](#) whose local name was **bad-1**.

3. Let *definition* be the entry in *registry* with [constructor](#) equal to [NewTarget](#). If there is no such definition, then throw a [TypeError](#).

Since there can be no entry in *registry* with a [constructor](#) of undefined, this step also prevents HTML element constructors from being called as functions (since in that case [NewTarget](#) will be undefined).

4. Let *is value* be null.
5. If *definition*'s [local name](#) is equal to *definition*'s [name](#) (i.e., *definition* is for an [autonomous custom element](#)), then:
 1. If the [active function object](#) is not [HTMLElement](#), then throw a [TypeError](#).

This can occur when a custom element is defined to not extend any local names, but inherits from a non-[HTMLElement](#) class:

```
customElements.define("bad-2", class Bad2 extends HTMLParagraphEl
```

In this case, during the (implicit) [super\(\)](#) call that occurs when constructing an instance of **Bad2**, the [active function object](#) is [HTMLParagraphElement](#), not [HTMLElement](#).

6. Otherwise (i.e., if *definition* is for a [customized built-in element](#)):

1. Let *valid local names* be the list of local names for elements defined in this specification or in [other applicable specifications](#) that use the [active function object](#) as their [element interface](#).
2. If *valid local names* does not contain *definition*'s [local name](#), then throw a [TypeError](#).

This can occur when a custom element is defined to extend a given local name but inherits from the wrong class:

```
customElements.define("bad-3", class Bad3 extends HTMLQuoteElement
```

In this case, during the (implicit) `super()` call that occurs when constructing an instance of `Bad3`, *valid local names* is the list containing `q` and `blockquote`, but *definition's local name* is `p`, which is not in that list.

3. Set *is value* to *definition's name*.
7. If *definition's construction stack* is empty, then:
 1. Let *element* be the result of internally creating a new object implementing the interface to which the active function object corresponds, given the current Realm Record and NewTarget.
 2. Set *element's node document* to the current global object's associated Document.
 3. Set *element's namespace* to the HTML namespace.
 4. Set *element's namespace prefix* to null.
 5. Set *element's local name* to *definition's local name*.
 6. Set *element's custom element state* to "custom".
 7. Set *element's custom element definition* to *definition*.
 8. Set *element's is value* to *is value*.
 9. Return *element*.

This occurs when author script constructs a new custom element directly, e.g. via `new MyCustomElement()`.

8. Let *prototype* be Get(NewTarget, "prototype"). Rethrow any exceptions.
9. If Type(prototype) is not Object, then:
 1. Let *realm* be GetFunctionRealm(NewTarget).
 2. Set *prototype* to the interface prototype object of *realm* whose interface is the same as the interface of the active function object.

The realm of the active function object might not be *realm*, so we are using the more general concept of "the same interface" across realms; we are not looking for equality of interface objects. This fallback behavior, including using the realm of NewTarget and looking up the appropriate prototype there, is designed to match analogous behavior for the JavaScript built-ins and Web IDL's internally create a new object implementing the interface algorithm.

10. Let *element* be the last entry in *definition*'s [construction stack](#).
11. If *element* is an [already constructed marker](#), then throw an "[InvalidStateError](#)" [DOMException](#).

This can occur when the author code inside the [custom element constructor non-conformantly](#) creates another instance of the class being constructed, before calling `super()`:

```
let doSillyThing = false;

class DontDoThis extends HTMLElement {
  constructor() {
    if (doSillyThing) {
      doSillyThing = false;
      new DontDoThis();
      // Now the construction stack will contain an already constructed
    }

    // This will then fail with an "InvalidStateError" DOMException:
    super();
  }
}
```

This can also occur when author code inside the [custom element constructor non-conformantly](#) calls `super()` twice, since per the JavaScript specification, this actually executes the superclass constructor (i.e. this algorithm) twice, before throwing an error:

```
class DontDoThisEither extends HTMLElement {
  constructor() {
    super();

    // This will throw, but not until it has already called into the HTM
    super();
  }
}
```

12. Perform `element.[[SetPrototypeOf]](prototype)`. Rethrow any exceptions.
13. Replace the last entry in *definition*'s [construction stack](#) with an [already constructed marker](#).
14. Return *element*.

This step is normally reached when [upgrading](#) a custom element; the existing element is returned, so that the `super()` call inside the [custom element constructor](#) assigns that existing element to `this`.

In addition to the constructor behavior implied by [\[HTMLConstructor\]](#), some elements also have [named constructors](#) (which are really factory functions with a modified `prototype` property).

Named constructors for HTML elements can also be used in an `extends` clause when defining a [custom element constructor](#):

```
class AutoEmbiggenedImage extends Image {  
    constructor(width, height) {  
        super(width * 10, height * 10);  
    }  
}  
  
customElements.define("auto-embiggened", AutoEmbiggenedImage, { extends: "img"  
  
const image = new AutoEmbiggenedImage(15, 20);  
console.assert(image.width === 150);  
console.assert(image.height === 200);
```

3.2.4 Element definitions

Each element in this specification has a definition that includes the following information:

Categories

A list of [categories](#) to which the element belongs. These are used when defining the [content models](#) for each element.

Contexts in which this element can be used

A *non-normative* description of where the element can be used. This information is redundant with the content models of elements that allow this one as a child, and is provided only as a convenience.

For simplicity, only the most specific expectations are listed.

For example, all [phrasing content](#) is [flow content](#). Thus, elements that are [phrasing content](#) will only be listed as "where [phrasing content](#) is expected", since this is the more-specific expectation. Anywhere that expects [flow content](#) also expects [phrasing content](#), and thus also meets this expectation.

Content model

A normative description of what content must be included as children and descendants of the element.

Tag omission in text/html

A non-normative description of whether, in the [text/html](#) syntax, the [start](#) and [end](#) tags can be omitted. This information is redundant with the normative requirements given in the [optional tags](#) section, and is provided in the element definitions only as a convenience.

Content attributes

A normative list of attributes that may be specified on the element (except where otherwise disallowed), along with non-normative descriptions of those attributes. (The content to the left of the dash is normative, the content to the right of the dash is not.)

Accessibility considerations

For authors: Conformance requirements for use of ARIA [role](#) and [aria-*](#) attributes are defined in *ARIA in HTML*. [\[ARIA\]](#) [\[ARIAHTML\]](#)

For implementers: User agent requirements for implementing accessibility API semantics are defined in *HTML Accessibility API Mappings*. [\[HTMLAAM\]](#)

DOM interface

A normative definition of a DOM interface that such elements must implement.

This is then followed by a description of what the element [represents](#), along with any additional normative conformance criteria that may apply to authors and implementations. Examples are sometimes also included.

3.2.4.1 Attributes

An attribute value is a string. Except where otherwise specified, attribute values on [HTML elements](#) may be any string value, including the empty string, and there is no restriction on what text can be specified in such attribute values.

3.2.5 Content models

Each element defined in this specification has a content model: a description of the element's expected [contents](#). An [HTML element](#) must have contents that match the requirements described in the element's content model. The *contents* of an element are its children in the DOM.

[ASCII whitespace](#) is always allowed between elements. User agents represent these characters between elements in the source markup as [Text](#) nodes in the DOM. Empty [Text](#) nodes and [Text](#) nodes consisting of just sequences of those characters are considered *inter-element whitespace*.

[Inter-element whitespace](#), comment nodes, and processing instruction nodes must be ignored

when establishing whether an element's contents match the element's content model or not, and must be ignored when following algorithms that define document and element semantics.

Thus, an element *A* is said to be *preceded or followed* by a second element *B* if *A* and *B* have the same parent node and there are no other element nodes or [Text](#) nodes (other than [inter-element whitespace](#)) between them. Similarly, a node is the *only child* of an element if that element contains no other nodes other than [inter-element whitespace](#), comment nodes, and processing instruction nodes.

Authors must not use [HTML elements](#) anywhere except where they are explicitly allowed, as defined for each element, or as explicitly required by other specifications. For XML compound documents, these contexts could be inside elements from other namespaces, if those elements are defined as providing the relevant contexts.

The Atom Syndication Format defines a **content** element. When its **type** attribute has the value **xhtml**, *The Atom Syndication Format* requires that it contain a single HTML [div](#) element. Thus, a [div](#) element is allowed in that context, even though this is not explicitly normatively stated by this specification. [\[ATOM\]](#)

In addition, [HTML elements](#) may be orphan nodes (i.e. without a parent node).

For example, creating a [td](#) element and storing it in a global variable in a script is conforming, even though [td](#) elements are otherwise only supposed to be used inside [tr](#) elements.

```
var data = {
  name: "Banana",
  cell: document.createElement('td'),
};
```

3.2.5.1 The "nothing" content model

When an element's content model is *nothing*, the element must contain no [Text](#) nodes (other than [inter-element whitespace](#)) and no element nodes.

Most HTML elements whose content model is "nothing" are also, for convenience, [void elements](#) (elements that have no [end tag](#) in the [HTML syntax](#)). However, these are entirely separate concepts.

3.2.5.2 Kinds of content

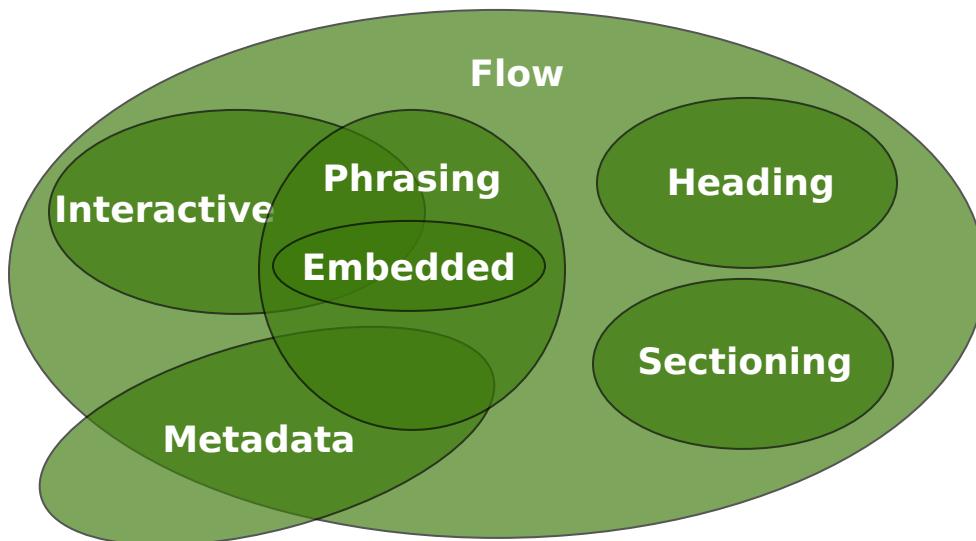
Each element in HTML falls into zero or more *categories* that group elements with similar characteristics together. The following broad categories are used in this specification:

- [Metadata content](#)
- [Flow content](#)
- [Sectioning content](#)
- [Heading content](#)

- [Phrasing content](#)
- [Embedded content](#)
- [Interactive content](#)

Some elements also fall into other categories, which are defined in other parts of this specification.

These categories are related as follows:



Sectioning content, heading content, phrasing content, embedded content, and interactive content are all types of flow content. Metadata is sometimes flow content. Metadata and interactive content are sometimes phrasing content. Embedded content is also a type of phrasing content, and sometimes is interactive content.

Other categories are also used for specific purposes, e.g. form controls are specified using a number of categories to define common requirements. Some elements have unique requirements and do not fit into any particular category.

3.2.5.2.1 Metadata content

Metadata content is content that sets up the presentation or behavior of the rest of the content, or that sets up the relationship of the document with other documents, or that conveys other "out of band" information.

- [base](#)
- [link](#)
- [meta](#)
- [noscript](#)
- [script](#)
- [style](#)

- [template](#)
- [title](#)

Elements from other namespaces whose semantics are primarily metadata-related (e.g. RDF) are also [metadata content](#).

Thus, in the XML serialization, one can use RDF, like this:

```
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:r="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xml:lang="en">
  <head>
    <title>Hedral's Home Page</title>
    <r:RDF>
      <Person xmlns="http://www.w3.org/2000/10/swap/pim/contact#"
              r:about="https://hedral.example.com/#">
        <fullName>Cat Hedral</fullName>
        <mailbox r:resource="mailto:hedral@damowmow.com"/>
        <personalTitle>Sir</personalTitle>
      </Person>
    </r:RDF>
  </head>
  <body>
    <h1>My home page</h1>
    <p>I like playing with string, I guess. Sister says squirrels are fun
       too so sometimes I follow her to play with them.</p>
  </body>
</html>
```

This isn't possible in the HTML serialization, however.

3.2.5.2.2 Flow content

Most elements that are used in the body of documents and applications are categorized as *flow content*.

- [a](#)
- [abbr](#)
- [address](#)
- [area](#) (if it is a descendant of a [map](#) element)
- [article](#)
- [aside](#)
- [audio](#)
- [b](#)
- [bdi](#)
- [bdo](#)
- [blockquote](#)

- [br](#)
- [button](#)
- [canvas](#)
- [cite](#)
- [code](#)
- [data](#)
- [datalist](#)
- [del](#)
- [details](#)
- [dfn](#)
- [dialog](#)
- [div](#)
- [dl](#)
- [em](#)
- [embed](#)
- [fieldset](#)
- [figure](#)
- [footer](#)
- [form](#)
- [h1](#)
- [h2](#)
- [h3](#)
- [h4](#)
- [h5](#)
- [h6](#)
- [header](#)
- [hgroup](#)
- [hr](#)
- [i](#)
- [iframe](#)
- [img](#)
- [input](#)
- [ins](#)
- [kbd](#)
- [label](#)
- [link](#) (if it is [allowed in the body](#))
- [main](#) (if it is a [hierarchically correct main element](#))
- [map](#)
- [mark](#)
- [MathML math](#)
- [menu](#)
- [meta](#) (if the [itemprop](#) attribute is present)
- [meter](#)
- [nav](#)
- [noscript](#)

- [object](#)
- [ol](#)
- [output](#)
- [p](#)
- [picture](#)
- [pre](#)
- [progress](#)
- [q](#)
- [ruby](#)
- [s](#)
- [samp](#)
- [script](#)
- [section](#)
- [select](#)
- [slot](#)
- [small](#)
- [span](#)
- [strong](#)
- [sub](#)
- [sup](#)
- [SVG svg](#)
- [table](#)
- [template](#)
- [textarea](#)
- [time](#)
- [u](#)
- [ul](#)
- [var](#)
- [video](#)
- [wbr](#)
- [autonomous custom elements](#)
- [text](#)

3.2.5.2.3 Sectioning content

Sectioning content is content that defines the scope of [headings](#) and [footers](#).

- [article](#)
- [aside](#)
- [nav](#)
- [section](#)

Each [sectioning content](#) element potentially has a heading and an [outline](#). See the section on [headings and sections](#) for further details.

There are also certain elements that are [sectioning roots](#). These are distinct from [sectioning content](#), but they can also have an [outline](#).

3.2.5.2.4 Heading content

Heading content defines the header of a section (whether explicitly marked up using [sectioning content](#) elements, or implied by the heading content itself).

- [h1](#)
- [h2](#)
- [h3](#)
- [h4](#)
- [h5](#)
- [h6](#)
- [hgroup](#)

3.2.5.2.5 Phrasing content

Phrasing content is the text of the document, as well as elements that mark up that text at the intra-paragraph level. Runs of [phrasing content](#) form [paragraphs](#).

- [a](#)
- [abbr](#)
- [area](#) (if it is a descendant of a [map](#) element)
- [audio](#)
- [b](#)
- [bdi](#)
- [bdo](#)
- [br](#)
- [button](#)
- [canvas](#)
- [cite](#)
- [code](#)
- [data](#)
- [datalist](#)
- [del](#)
- [dfn](#)
- [em](#)
- [embed](#)
- [i](#)
- [iframe](#)
- [img](#)
- [input](#)
- [ins](#)
- [kbd](#)

- [label](#)
- [link](#) (if it is [allowed in the body](#))
- [map](#)
- [mark](#)
- [MathML math](#)
- [meta](#) (if the `itemprop` attribute is present)
- [meter](#)
- [noscript](#)
- [object](#)
- [output](#)
- [picture](#)
- [progress](#)
- [q](#)
- [ruby](#)
- [s](#)
- [samp](#)
- [script](#)
- [select](#)
- [slot](#)
- [small](#)
- [span](#)
- [strong](#)
- [sub](#)
- [sup](#)
- [SVG svg](#)
- [template](#)
- [textarea](#)
- [time](#)
- [u](#)
- [var](#)
- [video](#)
- [wbr](#)
- [autonomous custom elements](#)
- [text](#)

Most elements that are categorized as phrasing content can only contain elements that are themselves categorized as phrasing content, not any flow content.

Text, in the context of content models, means either nothing, or [Text](#) nodes. [Text](#) is sometimes used as a content model on its own, but is also [phrasing content](#), and can be [inter-element whitespace](#) (if the [Text](#) nodes are empty or contain just [ASCII whitespace](#)).

[Text](#) nodes and attribute values must consist of [scalar values](#), excluding [noncharacters](#), and [controls](#) other than [ASCII whitespace](#). This specification includes extra constraints on the exact value of [Text](#) nodes and attribute values depending on their precise context.

3.2.5.2.6 Embedded content

Embedded content is content that imports another resource into the document, or content from another vocabulary that is inserted into the document.

- [audio](#)
- [canvas](#)
- [embed](#)
- [iframe](#)
- [img](#)
- [MathML math](#)
- [object](#)
- [picture](#)
- [SVG svg](#)
- [video](#)

Elements that are from namespaces other than the [HTML namespace](#) and that convey content but not metadata, are [embedded content](#) for the purposes of the content models defined in this specification. (For example, MathML or SVG.)

Some embedded content elements can have *fallback content*: content that is to be used when the external resource cannot be used (e.g. because it is of an unsupported format). The element definitions state what the fallback is, if any.

3.2.5.2.7 Interactive content

Interactive content is content that is specifically intended for user interaction.

- [a](#) (if the [href](#) attribute is present)
- [audio](#) (if the [controls](#) attribute is present)
- [button](#)
- [details](#)
- [embed](#)
- [iframe](#)
- [img](#) (if the [usemap](#) attribute is present)
- [input](#) (if the [type](#) attribute is *not* in the [Hidden](#) state)
- [label](#)
- [select](#)
- [textarea](#)
- [video](#) (if the [controls](#) attribute is present)

3.2.5.2.8 Palpable content

As a general rule, elements whose content model allows any [flow content](#) or [phrasing content](#) should have at least one node in its [contents](#) that is *palpable content* and that does not have the

[hidden](#) attribute specified.

[Palpable content](#) makes an element non-empty by providing either some descendant non-empty [text](#), or else something users can hear ([audio](#) elements) or view ([video](#), [img](#), or [canvas](#) elements) or otherwise interact with (for example, interactive form controls).

This requirement is not a hard requirement, however, as there are many cases where an element can be empty legitimately, for example when it is used as a placeholder which will later be filled in by a script, or when the element is part of a template and would on most pages be filled in but on some pages is not relevant.

Conformance checkers are encouraged to provide a mechanism for authors to find elements that fail to fulfill this requirement, as an authoring aid.

The following elements are palpable content:

- [a](#)
- [abbr](#)
- [address](#)
- [article](#)
- [aside](#)
- [audio](#) (if the [controls](#) attribute is present)
- [b](#)
- [bdi](#)
- [bdo](#)
- [blockquote](#)
- [button](#)
- [canvas](#)
- [cite](#)
- [code](#)
- [data](#)
- [details](#)
- [dfn](#)
- [div](#)
- [dl](#) (if the element's children include at least one name-value group)
- [em](#)
- [embed](#)
- [fieldset](#)
- [figure](#)
- [footer](#)
- [form](#)
- [h1](#)
- [h2](#)
- [h3](#)
- [h4](#)
- [h5](#)

- [h6](#)
- [header](#)
- [hgroup](#)
- [i](#)
- [iframe](#)
- [img](#)
- [input](#) (if the `type` attribute is *not* in the [Hidden](#) state)
- [ins](#)
- [kbd](#)
- [label](#)
- [main](#)
- [map](#)
- [mark](#)
- [MathML math](#)
- [menu](#) (if the element's children include at least one [li](#) element)
- [meter](#)
- [nav](#)
- [object](#)
- [ol](#) (if the element's children include at least one [li](#) element)
- [output](#)
- [p](#)
- [pre](#)
- [progress](#)
- [q](#)
- [ruby](#)
- [s](#)
- [samp](#)
- [section](#)
- [select](#)
- [small](#)
- [span](#)
- [strong](#)
- [sub](#)
- [sup](#)
- [SVG svg](#)
- [table](#)
- [textarea](#)
- [time](#)
- [u](#)
- [ul](#) (if the element's children include at least one [li](#) element)
- [var](#)
- [video](#)
- [autonomous custom elements](#)
- [text](#) that is not [inter-element whitespace](#)

3.2.5.2.9 Script-supporting elements

Script-supporting elements are those that do not [represent](#) anything themselves (i.e. they are not rendered), but are used to support scripts, e.g. to provide functionality for the user.

The following elements are script-supporting elements:

- [script](#)
- [template](#)

3.2.5.3 Transparent content models

Some elements are described as *transparent*; they have "transparent" in the description of their content model. The content model of a [transparent](#) element is derived from the content model of its parent element: the elements required in the part of the content model that is "transparent" are the same elements as required in the part of the content model of the parent of the transparent element in which the transparent element finds itself.

For instance, an [ins](#) element inside a [ruby](#) element cannot contain an [rt](#) element, because the part of the [ruby](#) element's content model that allows [ins](#) elements is the part that allows [phrasing content](#), and the [rt](#) element is not [phrasing content](#).

In some cases, where transparent elements are nested in each other, the process has to be applied iteratively.

Consider the following markup fragment:

```
<p><object><param><ins><map><a href="/">Apples</a></map></ins></object></p>
```

To check whether "Apples" is allowed inside the [a](#) element, the content models are examined. The [a](#) element's content model is transparent, as is the [map](#) element's, as is the [ins](#) element's, as is the part of the [object](#) element's in which the [ins](#) element is found. The [object](#) element is found in the [p](#) element, whose content model is [phrasing content](#). Thus, "Apples" is allowed, as text is phrasing content.

When a transparent element has no parent, then the part of its content model that is "transparent" must instead be treated as accepting any [flow content](#).

3.2.5.4 Paragraphs

The term [paragraph](#) as defined in this section is used for more than just the definition of the [p](#) element. The [paragraph](#) concept defined here is used to describe how to interpret documents. The [p](#) element is merely one of several ways of marking up a [paragraph](#).

A *paragraph* is typically a run of [phrasing content](#) that forms a block of text with one or more sentences that discuss a particular topic, as in typography, but can also be used for more general thematic grouping. For instance, an address is also a paragraph, as is a part of a form, a

byline, or a stanza in a poem.

In the following example, there are two paragraphs in a section. There is also a heading, which contains phrasing content that is not a paragraph. Note how the comments and [inter-element whitespace](#) do not form paragraphs.

```
<section>
  <h1>Example of paragraphs</h1>
  This is the <em>first</em> paragraph in this example.
  <p>This is the second.</p>
  <!-- This is not a paragraph. -->
</section>
```

Paragraphs in [flow content](#) are defined relative to what the document looks like without the [a](#), [ins](#), [del](#), and [map](#) elements complicating matters, since those elements, with their hybrid content models, can straddle paragraph boundaries, as shown in the first two examples below.

Generally, having elements straddle paragraph boundaries is best avoided. Maintaining such markup can be difficult.

The following example takes the markup from the earlier example and puts [ins](#) and [del](#) elements around some of the markup to show that the text was changed (though in this case, the changes admittedly don't make much sense). Notice how this example has exactly the same paragraphs as the previous one, despite the [ins](#) and [del](#) elements — the [ins](#) element straddles the heading and the first paragraph, and the [del](#) element straddles the boundary between the two paragraphs.

```
<section>
  <ins><h1>Example of paragraphs</h1>
  This is the <em>first</em> paragraph in</ins> this example<del>.
  <p>This is the second.</p></del>
  <!-- This is not a paragraph. -->
</section>
```

Let `view` be a view of the DOM that replaces all [a](#), [ins](#), [del](#), and [map](#) elements in the document with their [contents](#). Then, in `view`, for each run of sibling [phrasing content](#) nodes uninterrupted by other types of content, in an element that accepts content other than [phrasing content](#) as well as [phrasing content](#), let `first` be the first node of the run, and let `last` be the last node of the run. For each such run that consists of at least one node that is neither [embedded content](#) nor [inter-element whitespace](#), a paragraph exists in the original DOM from immediately before `first` to immediately after `last`. (Paragraphs can thus span across [a](#), [ins](#), [del](#), and [map](#) elements.)

Conformance checkers may warn authors of cases where they have paragraphs that overlap each other (this can happen with [object](#), [video](#), [audio](#), and [canvas](#) elements, and indirectly through elements in other namespaces that allow HTML to be further embedded therein, like [SVG](#) [svg](#) or [MathML](#) [math](#)).

A [paragraph](#) is also formed explicitly by [p](#) elements.

The [p](#) element can be used to wrap individual paragraphs when there would otherwise not be any content other than phrasing content to separate the paragraphs from each other.

In the following example, the link spans half of the first paragraph, all of the heading separating the two paragraphs, and half of the second paragraph. It straddles the paragraphs and the heading.

```
<header>
  Welcome!
  <a href="about.html">
    This is home of...
    <h1>The Falcons!</h1>
    The Lockheed Martin multirole jet fighter aircraft!
  </a>
  This page discusses the F-16 Fighting Falcon's innermost secrets.
</header>
```

Here is another way of marking this up, this time showing the paragraphs explicitly, and splitting the one link element into three:

```
<header>
  <p>Welcome! <a href="about.html">This is home of...</a></p>
  <h1><a href="about.html">The Falcons!</a></h1>
  <p><a href="about.html">The Lockheed Martin multirole jet
  fighter aircraft!</a> This page discusses the F-16 Fighting
  Falcon's innermost secrets.</p>
</header>
```

It is possible for paragraphs to overlap when using certain elements that define fallback content. For example, in the following section:

```
<section>
  <h1>My Cats</h1>
  You can play with my cat simulator.
  <object data="cats.sim">
    To see the cat simulator, use one of the following links:
    <ul>
      <li><a href="cats.sim">Download simulator file</a>
      <li><a href="https://sims.example.com/watch?v=LYds5xY4INU">Use online simu
    </ul>
    Alternatively, upgrade to the Mellblom Browser.
  </object>
  I'm quite proud of it.
</section>
```

There are five paragraphs:

1. The paragraph that says "You can play with my cat simulator. *object* I'm quite proud of it.", where *object* is the [object](#) element.
2. The paragraph that says "To see the cat simulator, use one of the following links:".
3. The paragraph that says "Download simulator file".
4. The paragraph that says "Use online simulator".
5. The paragraph that says "Alternatively, upgrade to the Mellblom Browser.".

The first paragraph is overlapped by the other four. A user agent that supports the "cats.sim" resource will only show the first one, but a user agent that shows the fallback will confusingly show the first sentence of the first paragraph as if it was in the same paragraph as the second one, and will show the last paragraph as if it was at the start of the second sentence of the first paragraph.

To avoid this confusion, explicit [p](#) elements can be used. For example:

```
<section>
  <h1>My Cats</h1>
  <p>You can play with my cat simulator.</p>
  <object data="cats.sim">
    <p>To see the cat simulator, use one of the following links:</p>
    <ul>
      <li><a href="cats.sim">Download simulator file</a>
      <li><a href="https://sims.example.com/watch?v=LYds5xY4INU">Use online simu
    </ul>
    <p>Alternatively, upgrade to the Mellblom Browser.</p>
  </object>
  <p>I'm quite proud of it.</p>
</section>
```

3.2.6 Global attributes

MDN

[Global_attributes](#)

The following attributes are common to and may be specified on all [HTML elements](#) (even those not defined in this specification):

- [accesskey](#)
- [autocapitalize](#)
- [autofocus](#)
- [contenteditable](#)
- [dir](#)
- [draggable](#)

- [enterkeyhint](#)
- [hidden](#)
- [inputmode](#)
- [is](#)
- [itemid](#)
- [itemprop](#)
- [itemref](#)
- [itemscope](#)
- [itemtype](#)
- [lang](#)
- [nonce](#)
- [spellcheck](#)
- [style](#)
- [tabindex](#)
- [title](#)
- [translate](#)

These attributes are only defined by this specification as attributes for [HTML elements](#). When this specification refers to elements having these attributes, elements from namespaces that are not defined as having these attributes must not be considered as being elements with these attributes.

For example, in the following XML fragment, the "bogus" element does not have a [dir](#) attribute as defined in this specification, despite having an attribute with the literal name "dir". Thus, [the directionality](#) of the inner-most [span](#) element is 'rtl', inherited from the [div](#) element indirectly through the "bogus" element.

```
<div xmlns="http://www.w3.org/1999/xhtml" dir="rtl">
  <bogus xmlns="https://example.net/ns" dir="ltr">
    <span xmlns="http://www.w3.org/1999/xhtml">
      </span>
    </bogus>
  </div>
```



[Global_attributes/slot](#)

Support in all current engines.

Firefox 63+ Safari 10+ Chrome 53+

Opera 40+ Edge 79+

Edge (Legacy) No Internet Explorer?

Firefox Android 63+ Safari iOS 10+ Chrome Android 53+ WebView Android 53+ Samsung Internet 6.0+ Opera Android 41+

DOM defines the user agent requirements for the `class`, `id`, and `slot` attributes for any element in any namespace. [DOM]

The `class`, `id`, and `slot` attributes may be specified on all [HTML elements](#).

When specified on [HTML elements](#), the `class` attribute must have a value that is a [set of space-separated tokens](#) representing the various classes that the element belongs to.

Assigning classes to an element affects class matching in selectors in CSS, the [`getElementsByClassName\(\)`](#) method in the DOM, and other such features.

There are no additional restrictions on the tokens authors can use in the `class` attribute, but authors are encouraged to use values that describe the nature of the content, rather than values that describe the desired presentation of the content.

When specified on [HTML elements](#), the `id` attribute value must be unique amongst all the [IDs](#) in the element's [tree](#) and must contain at least one character. The value must not contain any [ASCII whitespace](#).

The `id` attribute specifies its element's [unique identifier \(ID\)](#).

There are no other restrictions on what form an ID can take; in particular, IDs can consist of just digits, start with a digit, start with an underscore, consist of just punctuation, etc.

An element's [unique identifier](#) can be used for a variety of purposes, most notably as a way to link to specific parts of a document using [fragments](#), as a way to target an element when scripting, and as a way to style a specific element from CSS.

Identifiers are opaque strings. Particular meanings should not be derived from the value of the `id` attribute.

There are no conformance requirements for the `slot` attribute specific to [HTML elements](#).

The `slot` attribute is used to [assign a slot](#) to an element: an element with a `slot` attribute is [assigned](#) to the `slot` created by the `slot` element whose `name` attribute's value matches that `slot` attribute's value — but only if that `slot` element finds itself in the [shadow tree](#) whose [root's host](#) has the corresponding `slot` attribute value.

To enable assistive technology products to expose a more fine-grained interface than is otherwise possible with HTML elements and attributes, a set of [annotations for assistive technology products](#) can be specified (the ARIA `role` and `aria-*` attributes). [ARIA]

The following [event handler content attributes](#) may be specified on any [HTML element](#):

- [onauxclick](#)

- [onblur](#)*
- [oncancel](#)
- [oncanplay](#)
- [oncanplaythrough](#)
- [onchange](#)
- [onclick](#)
- [onclose](#)
- [oncontextlost](#)
- [oncontextmenu](#)
- [oncontextrestored](#)
- [oncopy](#)
- [oncuechange](#)
- [oncut](#)
- [ondblclick](#)
- [ondrag](#)
- [ondragend](#)
- [ondragenter](#)
- [ondragleave](#)
- [ondragover](#)
- [ondragstart](#)
- [ondrop](#)
- [ondurationchange](#)
- [onemptied](#)
- [onended](#)
- [onerror](#)*
- [onfocus](#)*
- [onformdata](#)
- [oninput](#)
- [oninvalid](#)
- [onkeydown](#)
- [onkeypress](#)
- [onkeyup](#)
- [onload](#)*
- [onloadeddata](#)
- [onloadedmetadata](#)
- [onloadstart](#)
- [onmousedown](#)
- [onmouseenter](#)
- [onmouseleave](#)
- [onmousemove](#)
- [onmouseout](#)
- [onmouseover](#)
- [onmouseup](#)
- [onpaste](#)
- [onpause](#)

- [onplay](#)
- [onplaying](#)
- [onprogress](#)
- [onratechange](#)
- [onreset](#)
- [onresize](#)*
- [onscroll](#)*
- [onsecuritypolicyviolation](#)
- [onseeked](#)
- [onseeking](#)
- [onselect](#)
- [onslotchange](#)
- [onstalled](#)
- [onsubmit](#)
- [onsuspend](#)
- [ontimeupdate](#)
- [ontoggle](#)
- [onvolumechange](#)
- [onwaiting](#)
- [onwheel](#)

The attributes marked with an asterisk have a different meaning when specified on [body](#) elements as those elements expose [event handlers](#) of the [Window](#) object with the same names.

While these attributes apply to all elements, they are not useful on all elements. For example, only [media elements](#) will ever receive a [volumechange](#) event fired by the user agent.

[Custom data attributes](#) (e.g. `data-foldername` or `data-msgid`) can be specified on any [HTML element](#), to store custom data, state, annotations, and similar, specific to the page.

In [HTML documents](#), elements in the [HTML namespace](#) may have an `xmllns` attribute specified, if, and only if, it has the exact value "`http://www.w3.org/1999/xhtml`". This does not apply to [XML documents](#).

In HTML, the `xmllns` attribute has absolutely no effect. It is basically a talisman. It is allowed merely to make migration to and from XML mildly easier. When parsed by an [HTML parser](#), the attribute ends up in no namespace, not the "`http://www.w3.org/2000/xmllns/`" namespace like namespace declaration attributes in XML do.

In XML, an `xmllns` attribute is part of the namespace declaration mechanism, and an element cannot actually have an `xmllns` attribute in no namespace specified.

XML also allows the use of the `xml:space` attribute in the [XML namespace](#) on any element in

an [XML document](#). This attribute has no effect on [HTML elements](#), as the default behavior in HTML is to preserve whitespace. [\[XML\]](#)

There is no way to serialize the [xml:space](#) attribute on [HTML elements](#) in the [text/html](#) syntax.

3.2.6.1 The [title](#) attribute



[Global_attributes/title](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

The [title](#) attribute [represents](#) advisory information for the element, such as would be appropriate for a tooltip. On a link, this could be the title or a description of the target resource; on an image, it could be the image credit or a description of the image; on a paragraph, it could be a footnote or commentary on the text; on a citation, it could be further information about the source; on [interactive content](#), it could be a label for, or instructions for, use of the element; and so forth. The value is text.

Relying on the [title](#) attribute is currently discouraged as many user agents do not expose the attribute in an accessible manner as required by this specification (e.g., requiring a pointing device such as a mouse to cause a tooltip to appear, which excludes keyboard-only users and touch-only users, such as anyone with a modern phone or tablet).

If this attribute is omitted from an element, then it implies that the [title](#) attribute of the nearest ancestor [HTML element](#) with a [title](#) attribute set is also relevant to this element. Setting the attribute overrides this, explicitly stating that the advisory information of any ancestors is not relevant to this element. Setting the attribute to the empty string indicates that the element has no advisory information.

If the [title](#) attribute's value contains U+000A LINE FEED (LF) characters, the content is split into multiple lines. Each U+000A LINE FEED (LF) character represents a line break.

Caution is advised with respect to the use of newlines in [title](#) attributes.

For instance, the following snippet actually defines an abbreviation's expansion *with a line break in it*:

<p>My logs show that there was some interest in <abbr title="Hypertext Transport Protocol">HTTP</abbr> today.</p>

Some elements, such as [link](#), [abbr](#), and [input](#), define additional semantics for the [title](#) attribute beyond the semantics described above.

The *advisory information* of an element is the value that the following algorithm returns, with the algorithm being aborted once a value is returned. When the algorithm returns the empty string, then there is no advisory information.

1. If the element has a [title](#) attribute, then return its value.
2. If the element has a parent element, then return the parent element's [advisory information](#).
3. Return the empty string.

User agents should inform the user when elements have [advisory information](#), otherwise the information would not be discoverable.



[HTMLElement/title](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.0+ Opera Android 12.1+

The [title](#) IDL attribute must [reflect](#) the [title](#) content attribute.

3.2.6.2 The [lang](#) and [xml:lang](#) attributes



[Global_attributes/lang](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

The `lang` attribute (in no namespace) specifies the primary language for the element's contents and for any of the element's attributes that contain text. Its value must be a valid BCP 47 language tag, or the empty string. Setting the attribute to the empty string indicates that the primary language is unknown. [\[BCP47\]](#)

The `lang` attribute in the [XML namespace](#) is defined in XML. [\[XML\]](#)

If these attributes are omitted from an element, then the language of this element is the same as the language of its parent element, if any.

The `lang` attribute in no namespace may be used on any [HTML element](#).

The [lang attribute in the XML namespace](#) may be used on [HTML elements](#) in [XML documents](#), as well as elements in other namespaces if the relevant specifications allow it (in particular, MathML and SVG allow [lang attributes in the XML namespace](#) to be specified on their elements). If both the [lang attribute in no namespace](#) and the [lang attribute in the XML namespace](#) are specified on the same element, they must have exactly the same value when compared in an [ASCII case-insensitive](#) manner.

Authors must not use the [lang attribute in the XML namespace](#) on [HTML elements](#) in [HTML documents](#). To ease migration to and from XML, authors may specify an attribute in no namespace with no prefix and with the literal localname "`xml:lang`" on [HTML elements](#) in [HTML documents](#), but such attributes must only be specified if a [lang attribute in no namespace](#) is also specified, and both attributes must have the same value when compared in an [ASCII case-insensitive](#) manner.

The attribute in no namespace with no prefix and with the literal localname "`xml:lang`" has no effect on language processing.

To determine the *language* of a node, user agents must look at the nearest ancestor element (including the element itself if the node is an element) that has a [lang attribute in the XML namespace](#) set or is an [HTML element](#) and has a `lang` in no namespace attribute set. That attribute specifies the language of the node (regardless of its value).

If both the [lang attribute in no namespace](#) and the [lang attribute in the XML namespace](#) are set on an element, user agents must use the [lang attribute in the XML namespace](#), and the [lang attribute in no namespace](#) must be [ignored](#) for the purposes of determining the element's language.

If node's [inclusive ancestors](#) do not have either attribute set, but there is a [pragma-set default language](#) set, then that is the language of the node. If there is no [pragma-set default language](#) set, then language information from a higher-level protocol (such as HTTP), if any, must be used as the final fallback language instead. In the absence of any such language information, and in cases where the higher-level protocol reports multiple languages, the language of the

node is unknown, and the corresponding language tag is the empty string.

If the resulting value is not a recognized language tag, then it must be treated as an unknown language having the given language tag, distinct from all other languages. For the purposes of round-tripping or communicating with other services that expect language tags, user agents should pass unknown language tags through unmodified, and tagged as being BCP 47 language tags, so that subsequent services do not interpret the data as another type of language description. [\[BCP47\]](#)

Thus, for instance, an element with `lang="xyzzy"` would be matched by the selector `:lang(xyzzy)` (e.g. in CSS), but it would not be matched by `:lang(abcde)`, even though both are equally invalid. Similarly, if a web browser and screen reader working in unison communicated about the language of the element, the browser would tell the screen reader that the language was "xyzzy", even if it knew it was invalid, just in case the screen reader actually supported a language with that tag after all. Even if the screen reader supported both BCP 47 and another syntax for encoding language names, and in that other syntax the string "xyzzy" was a way to denote the Belarusian language, it would be *incorrect* for the screen reader to then start treating text as Belarusian, because "xyzzy" is not how Belarusian is described in BCP 47 codes (BCP 47 uses the code "be" for Belarusian).

If the resulting value is the empty string, then it must be interpreted as meaning that the language of the node is explicitly unknown.

User agents may use the element's language to determine proper processing or rendering (e.g. in the selection of appropriate fonts or pronunciations, for dictionary selection, or for the user interfaces of form controls such as date pickers).



[HTMLElement/lang](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.0+ Opera Android 12.1+

The `lang` IDL attribute must [reflect](#) the `lang` content attribute in no namespace.

3.2.6.3 The [translate](#) attribute



[Global_attributes/translate](#)

Firefox No Safari 6+ Chrome 19+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 6+ Chrome Android 25+ WebView Android 4.4+ Samsung

Internet 1.5+ Opera Android 14+

The **translate** attribute is an [enumerated attribute](#) that is used to specify whether an element's attribute values and the values of its [Text](#) node children are to be translated when the page is localized, or whether to leave them unchanged.

The attribute's keywords are the empty string, **yes**, and **no**. The empty string and the **yes** keyword map to the *yes* state. The **no** keyword maps to the *no* state. In addition, there is a third state, the *inherit* state, which is the [missing value default](#) and the [invalid value default](#).

Each element (even non-HTML elements) has a *translation mode*, which is in either the [translate-enabled](#) state or the [no-translate](#) state. If an [HTML element](#)'s [translate](#) attribute is in the *yes* state, then the element's [translation mode](#) is in the [translate-enabled](#) state; otherwise, if the element's [translate](#) attribute is in the *no* state, then the element's [translation mode](#) is in the [no-translate](#) state. Otherwise, either the element's [translate](#) attribute is in the *inherit* state, or the element is not an [HTML element](#) and thus does not have a [translate](#) attribute; in either case, the element's [translation mode](#) is in the same state as its parent element's, if any, or in the [translate-enabled](#) state, if the element is a [document element](#).

When an element is in the *translate-enabled* state, the element's [translatable attributes](#) and the values of its [Text](#) node children are to be translated when the page is localized.

When an element is in the *no-translate* state, the element's attribute values and the values of its [Text](#) node children are to be left as-is when the page is localized, e.g. because the element contains a person's name or a name of a computer program.

The following attributes are *translatable attributes*:

- [abbr](#) on [th](#) elements
- [alt](#) on [area](#), [img](#), and [input](#) elements
- [content](#) on [meta](#) elements, if the [name](#) attribute specifies a metadata name whose value is known to be translatable
- [download](#) on [a](#) and [area](#) elements
- [label](#) on [optgroup](#), [option](#), and [track](#) elements
- [lang](#) on [HTML elements](#); must be "translated" to match the language used in the translation
- [placeholder](#) on [input](#) and [textarea](#) elements
- [srcdoc](#) on [iframe](#) elements; must be parsed and recursively processed
- [style](#) on [HTML elements](#); must be parsed and recursively processed (e.g. for the values of '[content](#)' properties)

- [title](#) on all [HTML elements](#)
- [value](#) on [input](#) elements with a [type](#) attribute in the [Button](#) state or the [Reset Button](#) state

Other specifications may define other attributes that are also [translatable attributes](#). For example, [ARIA](#) would define the [aria-label](#) attribute as translatable.

The [translate](#) IDL attribute must, on getting, return true if the element's [translation mode](#) is [translate-enabled](#), and false otherwise. On setting, it must set the content attribute's value to "yes" if the new value is true, and set the content attribute's value to "no" otherwise.

In this example, everything in the document is to be translated when the page is localized, except the sample keyboard input and sample program output:

```
<!DOCTYPE HTML>
<html lang=en> <!-- default on the document element is translate=yes -->
<head>
  <title>The Bee Game</title> <!-- implied translate=yes inherited from ancestor -->
</head>
<body>
  <p>The Bee Game is a text adventure game in English.</p>
  <p>When the game launches, the first thing you should do is type
    <kbd translate=no>eat honey</kbd>. The game will respond with:</p>
    <pre><samp translate=no>Yum yum! That was some good honey!</samp></pre>
</body>
</html>
```

3.2.6.4 The [dir](#) attribute



[Global_attributes/dir](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) No Internet Explorer No

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

The [dir](#) attribute specifies the element's text directionality. The attribute is an [enumerated attribute](#) with the following keywords and states:

The ***ltr*** keyword, which maps to the *ltr* state

Indicates that the contents of the element are explicitly directionally isolated left-to-right text.

The ***rtl*** keyword, which maps to the *rtl* state

Indicates that the contents of the element are explicitly directionally isolated right-to-left text.

The ***auto*** keyword, which maps to the *auto* state

Indicates that the contents of the element are explicitly directionally isolated text, but that the direction is to be determined programmatically using the contents of the element (as described below).

The heuristic used by this state is very crude (it just looks at the first character with a strong directionality, in a manner analogous to the Paragraph Level determination in the bidirectional algorithm). Authors are urged to only use this value as a last resort when the direction of the text is truly unknown and no better server-side heuristic can be applied.

[BIDI]

For [textarea](#) and [pre](#) elements, the heuristic is applied on a per-paragraph level.

The attribute has no [*invalid value default*](#) and no [*missing value default*](#).

The *directionality* of an element (any element, not just an [HTML element](#)) is either '*ltr*' or '*rtl*', and is determined as per the first appropriate set of steps from the following list:

If the element's [**dir**](#) attribute is in the [*ltr*](#) state

If the element is a [document element](#) and the [**dir**](#) attribute is not in a defined state (i.e. it is not present or has an invalid value)

If the element is an [**input**](#) element whose [**type**](#) attribute is in the [*Telephone*](#) state, and the [**dir**](#) attribute is not in a defined state (i.e. it is not present or has an invalid value)

[The directionality](#) of the element is '*ltr*'.

If the element's [**dir**](#) attribute is in the [*rtl*](#) state

[The directionality](#) of the element is '*rtl*'.

If the element is an [**input**](#) element whose [**type**](#) attribute is in the [*Text*](#), [*Search*](#), [*Telephone*](#), [*URL*](#), or [*Email*](#) state, and the [**dir**](#) attribute is in the [*auto*](#) state

If the element is a [**textarea**](#) element and the [**dir**](#) attribute is in the [*auto*](#) state

If the element's [**value**](#) contains a character of bidirectional character type AL or R, and

there is no character of bidirectional character type L anywhere before it in the element's [value](#), then [the directionality](#) of the element is '[rtl](#)'. [\[BIDI\]](#)

Otherwise, if the element's [value](#) is not the empty string, or if the element is a [document element](#), [the directionality](#) of the element is '[ltr](#)'.

Otherwise, [the directionality](#) of the element is the same as the element's parent element's [directionality](#).

If the element's [dir](#) attribute is in the [auto](#) state

If the element is a [bdi](#) element and the [dir](#) attribute is not in a defined state (i.e. it is not present or has an invalid value)

Find the first character in [tree order](#) that matches the following criteria:

- The character is from a [Text](#) node that is a descendant of the element whose [directionality](#) is being determined.
- The character is of bidirectional character type L, AL, or R. [\[BIDI\]](#)
- The character is not in a [Text](#) node that has an ancestor element that is a descendant of the element whose [directionality](#) is being determined and that is either:
 - A [bdi](#) element.
 - A [script](#) element.
 - A [style](#) element.
 - A [textarea](#) element.
 - An element with a [dir](#) attribute in a defined state.

If such a character is found and it is of bidirectional character type AL or R, [the directionality](#) of the element is '[rtl](#)'.

If such a character is found and it is of bidirectional character type L, [the directionality](#) of the element is '[ltr](#)'.

Otherwise, if the element is a [document element](#), [the directionality](#) of the element is '[ltr](#)'.

Otherwise, [the directionality](#) of the element is the same as the element's parent element's [directionality](#).

If the element has a parent element and the [dir](#) attribute is not in a defined state (i.e. it is not present or has an invalid value)

[The directionality](#) of the element is the same as the element's parent element's [directionality](#).

Since the [dir](#) attribute is only defined for [HTML elements](#), it cannot be present on elements

from other namespaces. Thus, elements from other namespaces always just inherit their [directionality](#) from their parent element, or, if they don't have one, default to '[ltr](#)'.

This attribute [has rendering requirements involving the bidirectional algorithm](#).

The *directionality of an attribute* of an [HTML element](#), which is used when the text of that attribute is to be included in the rendering in some manner, is determined as per the first appropriate set of steps from the following list:

If the attribute is a [directionality-capable attribute](#) and the element's [dir](#) attribute is in the [auto](#) state

Find the first character (in logical order) of the attribute's value that is of bidirectional character type L, AL, or R. [\[BIDI\]](#)

If such a character is found and it is of bidirectional character type AL or R, the [directionality of the attribute](#) is '[rtl](#)'.

Otherwise, the [directionality of the attribute](#) is '[ltr](#)'.

Otherwise

The [directionality of the attribute](#) is the same as [the element's directionality](#).

The following attributes are *directionality-capable attributes*:

- [abbr](#) on [th](#) elements
- [alt](#) on [area](#), [img](#), and [input](#) elements
- [content](#) on [meta](#) elements, if the [name](#) attribute specifies a metadata name whose value is primarily intended to be human-readable rather than machine-readable
- [label](#) on [optgroup](#), [option](#), and [track](#) elements
- [placeholder](#) on [input](#) and [textarea](#) elements
- [title](#) on all [HTML elements](#)

`document.dir [= value]`

Returns [the html element's dir](#) attribute's value, if any.

Can be set, to either "[ltr](#)", "[rtl](#)", or "[auto](#)" to replace [the html element's dir](#) attribute's value.

If there is no [html element](#), returns the empty string and ignores new values.



Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung

Internet 1.0+ Opera Android 12.1+

The **dir** IDL attribute on an element must [reflect](#) the **dir** content attribute of that element, [limited to only known values](#).



[Document/dir](#)

Support in all current engines.

Firefox 1+ Safari 10.1+ Chrome 64+

Opera 51+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 10.3+ Chrome Android 64+ WebView Android 64+ Samsung

Internet 9.0+ Opera Android 47+

The **dir** IDL attribute on [Document](#) objects must [reflect](#) the **dir** content attribute of [the html element](#), if any, [limited to only known values](#). If there is no such element, then the attribute must return the empty string and do nothing on setting.

Authors are strongly encouraged to use the **dir** attribute to indicate text direction rather than using CSS, since that way their documents will continue to render correctly even in the absence of CSS (e.g. as interpreted by search engines).

This markup fragment is of an IM conversation.

```
<p dir="auto" class="u1"><b><bdi>Student</bdi></b> How do you write "What's yo<br/><p dir="auto" class="u2"><b><bdi>Teacher</bdi></b> ؟ اسمك ما</p><br/><p dir="auto" class="u1"><b><bdi>Student</bdi></b> Thanks.</p><br/><p dir="auto" class="u2"><b><bdi>Teacher</bdi></b> That's written "شكرا".</p><br/><p dir="auto" class="u2"><b><bdi>Teacher</bdi></b> Do you know how to write "P<br/><p dir="auto" class="u1"><b><bdi>Student</bdi></b> من فضلك", right?</p>
```

Given a suitable style sheet and the default alignment styles for the **p** element, namely to align the text to the *start edge* of the paragraph, the resulting rendering could be as follows:

Student: How do you write "What's your name?" in Arabic?
ما اسمك؟ : **Teacher**

Student: Thanks.

Teacher: That's written "شكراً".

Teacher: Do you know how to write "Please"?

?right , "من فضلك" : **Student**

As noted earlier, the `auto` value is not a panacea. The final paragraph in this example is misinterpreted as being right-to-left text, since it begins with an Arabic character, which causes the "right?" to be to the left of the Arabic text.

3.2.6.5 The `style` attribute



[Global_attributes/style](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

All [HTML elements](#) may have the `style` content attribute set. This is a [style attribute](#) as defined by [CSS Style Attributes](#). [\[CSSATTR\]](#)

In user agents that support CSS, the attribute's value must be parsed when the attribute is added or has its value changed, according to the rules given for [style attributes](#). [\[CSSATTR\]](#)

However, if the [Should element's inline behavior be blocked by Content Security Policy?](#) algorithm returns "Blocked" when executed upon the attribute's [element](#), "[style attribute](#)", and the attribute's value, then the style rules defined in the attribute's value must not be applied to the [element](#). [\[CSP\]](#)

Documents that use `style` attributes on any of their elements must still be comprehensible and usable if those attributes were removed.

In particular, using the `style` attribute to hide and show content, or to convey meaning that is otherwise not included in the document, is non-conforming. (To hide and show content, use the [hidden](#) attribute.)

`element.style`

Returns a [CSSStyleDeclaration](#) object for the element's `style` attribute.

The `style` IDL attribute is defined in *CSS Object Model*. [\[CSSOM\]](#)

In the following example, the words that refer to colors are marked up using the `span` element and the `style` attribute to make those words show up in the relevant colors in visual media.

```
<p>My sweat suit is <span style="color: green; background: transparent">green</span> and my eyes are <span style="color: blue; background: transparent">blue</span>.</p>
```

3.2.6.6 Embedding custom non-visible data with the `data-*` attributes



[Global_attributes/data-*](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

A *custom data attribute* is an attribute in no namespace whose name starts with the string "`data-`", has at least one character after the hyphen, is [XML-compatible](#), and contains no [ASCII upper alphas](#).

All attribute names on [HTML elements](#) in [HTML documents](#) get ASCII-lowercased automatically, so the restriction on ASCII uppercase letters doesn't affect such documents.

[Custom data attributes](#) are intended to store custom data, state, annotations, and similar, private to the page or application, for which there are no more appropriate attributes or elements.

These attributes are not intended for use by software that is not known to the administrators of the site that uses the attributes. For generic extensions that are to be used by multiple independent tools, either this specification should be extended to provide the feature explicitly, or a technology like [microdata](#) should be used (with a standardized vocabulary).

For instance, a site about music could annotate list items representing tracks in an album with custom data attributes containing the length of each track. This information could then be used by the site itself to allow the user to sort the list by track length, or to filter the list for tracks of certain lengths.

```
<ol>
  <li data-length="2m11s">Beyond The Sea</li>
  ...
</ol>
```

It would be inappropriate, however, for the user to use generic software not associated with that music site to search for tracks of a certain length by looking at this data.

This is because these attributes are intended for use by the site's own scripts, and are not a generic extension mechanism for publicly-usable metadata.

Similarly, a page author could write markup that provides information for a translation tool that they are intending to use:

```
<p>The third <span data-mytrans-de="Anspruch">claim</span> covers the case of
translate="no">HTML</span> markup.</p>
```

In this example, the "**data-mytrans-de**" attribute gives specific text for the MyTrans product to use when translating the phrase "claim" to German. However, the standard [translate](#) attribute is used to tell it that in all languages, "HTML" is to remain unchanged. When a standard attribute is available, there is no need for a [custom data attribute](#) to be used.

In this example, custom data attributes are used to store the result of a feature detection for [PaymentRequest](#), which could be used in CSS to style a checkout page differently.

```
<script>
  if ('PaymentRequest' in window) {
    document.documentElement.dataset.hasPaymentRequest = '';
  }
</script>
```

Here, the **data-has-payment-request** attribute is effectively being used as a [boolean attribute](#); it is enough to check the presence of the attribute. However, if the author so wishes, it could later be populated with some value, maybe to indicate limited functionality of the feature.

Every [HTML element](#) may have any number of [custom data attributes](#) specified, with any value.

Authors should carefully design such extensions so that when the attributes are ignored and any associated CSS dropped, the page is still usable.

User agents must not derive any implementation behavior from these attributes or values. Specifications intended for user agents must not define these attributes to have any meaningful values.

JavaScript libraries may use the [custom data attributes](#), as they are considered to be part of the page on which they are used. Authors of libraries that are reused by many authors are

encouraged to include their name in the attribute names, to reduce the risk of clashes. Where it makes sense, library authors are also encouraged to make the exact name used in the attribute names customizable, so that libraries whose authors unknowingly picked the same name can be used on the same page, and so that multiple versions of a particular library can be used on the same page even when those versions are not mutually compatible.

For example, a library called "DoQuery" could use attribute names like `data-doquery-range`, and a library called "jJo" could use attributes names like `data-jjo-range`. The jJo library could also provide an API to set which prefix to use (e.g. `J.setDataPrefix('j2')`, making the attributes have names like `data-j2-range`).

[element.dataset](#)



[HTMLElement/dataset](#)

Support in all current engines.

Firefox 6+ Safari 5.1+ Chrome 8+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 6+ Safari iOS 5+ Chrome Android 18+ WebView Android 4.4+ Samsung

Internet 1.0+ Opera Android 11+

[SVGElement/dataset](#)

Support in all current engines.

Firefox 51+ Safari 5.1+ Chrome 55+

Opera 41+ Edge 79+

Edge (Legacy) 17+ Internet Explorer No

Firefox Android 51+ Safari iOS 5+ Chrome Android 55+ WebView Android 55+ Samsung

Internet 6.0+ Opera Android 41+

Returns a [DOMStringMap](#) object for the element's `data-*` attributes.

Hyphenated names become camel-cased. For example, `data-foo-bar=""` becomes `element.dataset.fooBar`.

The `dataset` IDL attribute provides convenient accessors for all the `data-*` attributes on an element. On getting, the `dataset` IDL attribute must return a [DOMStringMap](#) whose associated element is this element.

The [DOMStringMap](#) interface is used for the `dataset` attribute. Each [DOMStringMap](#) has an associated element.

```
[Exposed=Window,
LegacyOverrideBuiltIns]
interface DOMStringMap {
  getter DOMString (DOMString name);
  [CEReactions] setter undefined (DOMString name, DOMString value);
  [CEReactions] deleter undefined (DOMString name);
};
```

To get a *DOMStringMap*'s name-value pairs, run the following algorithm:

1. Let *list* be an empty list of name-value pairs.
2. For each content attribute on the *DOMStringMap*'s *associated element* whose first five characters are the string "data-" and whose remaining characters (if any) do not include any *ASCII upper alphas*, in the order that those attributes are listed in the element's *attribute list*, add a name-value pair to *list* whose name is the attribute's name with the first five characters removed and whose value is the attribute's value.
3. For each name in *list*, for each U+002D HYPHEN-MINUS character (-) in the name that is followed by an *ASCII lower alpha*, remove the U+002D HYPHEN-MINUS character (-) and replace the character that followed it by the same character *converted to ASCII uppercase*.
4. Return *list*.

The *supported property names* on a *DOMStringMap* object at any instant are the names of each pair returned from *getting the DOMStringMap's name-value pairs* at that instant, in the order returned.

To *determine the value of a named property* *name* for a *DOMStringMap*, return the value component of the name-value pair whose name component is *name* in the list returned from *getting the DOMStringMap's name-value pairs*.

To *set the value of a new named property* or *set the value of an existing named property* for a *DOMStringMap*, given a property name *name* and a new value *value*, run the following steps:

1. If *name* contains a U+002D HYPHEN-MINUS character (-) followed by an *ASCII lower alpha*, then throw a "*SyntaxError*" *DOMException*.
2. For each *ASCII upper alpha* in *name*, insert a U+002D HYPHEN-MINUS character (-) before the character and replace the character with the same character *converted to ASCII lowercase*.
3. Insert the string **data-** at the front of *name*.
4. If *name* does not match the XML *Name* production, throw an "*InvalidCharacterError*" *DOMException*.

5. Set an attribute value for the [DOMStringMap](#)'s [associated element](#) using *name* and *value*.

To [delete an existing named property](#) *name* for a [DOMStringMap](#), run the following steps:

1. For each [ASCII upper alpha](#) in *name*, insert a U+002D HYPHEN-MINUS character (-) before the character and replace the character with the same character [converted to ASCII lowercase](#).
2. Insert the string **data-** at the front of *name*.
3. [Remove an attribute by name](#) given *name* and the [DOMStringMap](#)'s [associated element](#).

This algorithm will only get invoked by *Web IDL* for names that are given by the earlier algorithm for [getting the DOMStringMap's name-value pairs](#). [\[WEBIDL\]](#)

If a web page wanted an element to represent a space ship, e.g. as part of a game, it would have to use the [class](#) attribute along with [data-*](#) attributes:

```
<div class="spaceship" data-ship-id="92432"
    data-weapons="laser 2" data-shields="50%"
    data-x="30" data-y="10" data-z="90">
  <button class="fire"
    onclick="spaceships[this.parentNode.dataset.shipId].fire()">
    Fire
  </button>
</div>
```

Notice how the hyphenated attribute name becomes camel-cased in the API.

Given the following fragment and elements with similar constructions:

```

```

...one could imagine a function `splashDamage()` that takes some arguments, the first of which is the element to process:

```
function splashDamage(node, x, y, damage) {
  if (node.classList.contains('tower') && // checking the 'class' attribute
      node.dataset.x == x && // reading the 'data-x' attribute
      node.dataset.y == y) { // reading the 'data-y' attribute
    var hp = parseInt(node.dataset.hp); // reading the 'data-hp' attribute
    hp = hp - damage;
    if (hp < 0) {
```

```

        hp = 0;
        node.dataset.ai = 'dead'; // setting the 'data-ai' attribute
        delete node.dataset.ability; // removing the 'data-ability' attribute
    }
    node.dataset.hp = hp; // setting the 'data-hp' attribute
}
}

```

3.2.7 The `innerText` and `outerText` properties



[HTMLElement/innerText](#)

Support in all current engines.

Firefox 45+ Safari 3+ Chrome 1+

Opera 9.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 45+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung

Internet 1.0+ Opera Android 10.1+

`element.innerText [= value]`

Returns the element's text content "as rendered".

Can be set, to replace the element's children with the given value, but with line breaks converted to `br` elements.

`element.outerText [= value]`

Returns the element's text content "as rendered".

Can be set, to replace the element with the given value, but with line breaks converted to `br` elements.

The `innerText` and `outerText` getter steps are:

1. If `this` is not being rendered or if the user agent is a non-CSS user agent, then return `this`'s descendant text content.

This step can produce surprising results, as when the `innerText` getter is invoked on an element not being rendered, its text contents are returned, but when accessed on an element that is being rendered, all of its children that are not being rendered have their text contents ignored.

2. Let `results` be a new empty list.

3. For each child node *node* of [this](#):
 1. Let *current* be the [list](#) resulting in running the [rendered text collection steps](#) with *node*. Each item in *results* will either be a [string](#) or a positive integer (a *required line break count*).

Intuitively, a *required line break count* item means that a certain number of line breaks appear at that point, but they can be collapsed with the line breaks induced by adjacent *required line break count* items, reminiscent to CSS margin-collapsing.
 2. For each item *item* in *current*, append *item* to *results*.
 4. [Remove](#) any items from *results* that are the empty string.
 5. [Remove](#) any runs of consecutive *required line break count* items at the start or end of *results*.
 6. [Replace](#) each remaining run of consecutive *required line break count* items with a string consisting of as many U+000A LF code points as the maximum of the values in the *required line break count* items.
 7. Return the concatenation of the string items in *results*.

The *rendered text collection steps*, given a [node](#) *node*, are as follows:

1. Let *items* be the result of running the [rendered text collection steps](#) with each child node of *node* in [tree order](#), and then concatenating the results to a single [list](#).
2. If *node*'s [computed value](#) of '[visibility](#)' is not '[visible](#)', then return *items*.
3. If *node* is not [being rendered](#), then return *items*. For the purpose of this step, the following elements must act as described if the [computed value](#) of the '[display](#)' property is not '[none](#)':
 - [select](#) elements have an associated non-replaced inline [CSS box](#) whose child boxes include only those of [optgroup](#) and [option](#) element child nodes;
 - [optgroup](#) elements have an associated non-replaced block-level [CSS box](#) whose child boxes include only those of [option](#) element child nodes; and
 - [option](#) element have an associated non-replaced block-level [CSS box](#) whose child boxes are as normal for non-replaced block-level [CSS boxes](#).

items can be non-empty due to '[display:contents](#)'.

4. If *node* is a [Text](#) node, then for each CSS text box produced by *node*, in content order, compute the text of the box after application of the CSS '[white-space](#)' processing rules and '[text-transform](#)' rules, set *items* to the [list](#) of the resulting strings, and return *items*. The CSS '[white-space](#)' processing rules are slightly modified: collapsible spaces at the

end of lines are always collapsed, but they are only removed if the line is the last line of the block, or it ends with a [br](#) element. Soft hyphens should be preserved. [\[CSSTEXT\]](#)

5. If *node* is a [br](#) element, then [append](#) a string containing a single U+000A LF code point to *items*.
6. If *node*'s [computed value](#) of ['display'](#) is ['table-cell'](#), and *node*'s [CSS box](#) is not the last ['table-cell'](#) box of its enclosing ['table-row'](#) box, then [append](#) a string containing a single U+0009 TAB code point to *items*.
7. If *node*'s [computed value](#) of ['display'](#) is ['table-row'](#), and *node*'s [CSS box](#) is not the last ['table-row'](#) box of the nearest ancestor ['table'](#) box, then [append](#) a string containing a single U+000A LF code point to *items*.
8. If *node* is a [p](#) element, then [append](#) 2 (a *required line break count*) at the beginning and end of *items*.
9. If *node*'s [used value](#) of ['display'](#) is [block-level](#) or ['table-caption'](#), then [append](#) 1 (a *required line break count*) at the beginning and end of *items*. [\[CSSDISPLAY\]](#)

Floats and absolutely-positioned elements fall into this category.

10. Return *items*.

Note that descendant nodes of most replaced elements (e.g., [textarea](#), [input](#), and [video](#) — but not [button](#)) are not rendered by CSS, strictly speaking, and therefore have no [CSS boxes](#) for the purposes of this algorithm.

This algorithm is amenable to being generalized to work on [ranges](#). Then we can use it as the basis for [Selection](#)'s stringifier and maybe expose it directly on [ranges](#). See [Bugzilla bug 10583](#).

The [innerText](#) setter steps are:

1. Let *fragment* be the [rendered text fragment](#) for the given value given *this*'s [node document](#).
2. [Replace all](#) with *fragment* within [this](#).

The [outerText](#) setter steps are:

1. If *this*'s parent is null, then throw a ["NoModificationAllowedError"](#) [DOMException](#).
2. Let *next* be *this*'s [next sibling](#).
3. Let *previous* be *this*'s [previous sibling](#).

4. Let *fragment* be the [rendered text fragment](#) for the given value given [this's node document](#).
5. [Replace this](#) with *fragment* within [this](#)'s parent.
6. If *next* is non-null and *next*'s [previous sibling](#) is a [Text](#) node, then [merge with the next text node](#) given *next*'s [previous sibling](#).
7. If *previous* is a [Text](#) node, then [merge with the next text node](#) given *previous*.

The *rendered text fragment* for a string *input* given a [Document](#) *document* is the result of running the following steps:

1. Let *position* be a [position variable](#) for *input*, initially pointing at the start of *input*.
2. Let *text* be the empty string.
3. While *position* is not past the end of *input*:
 1. [Collect a sequence of code points](#) that are not U+000A LF or U+000D CR from *input* given *position*, and set *text* to the result.
 2. If *text* is not the empty string, then [append](#) a new [Text](#) node whose [data](#) is *text* and [node document](#) is *document* to *fragment*.
 3. While *position* is not past the end of *input*, and the code point at *position* is either U+000A LF or U+000D CR:
 1. If the code point at *position* is U+000D CR and the next code point is U+000A LF, then advance *position* to the next code point in *input*.
 2. Advance *position* to the next code point in *input*.
 3. [Append](#) the result of [creating an element](#) given *document*, [br](#), and the [HTML namespace](#) to *fragment*.

To [merge with the next text node](#) given a [Text](#) node *node*:

1. Let *next* be *node*'s [next sibling](#).
2. If *next* is not a [Text](#) node, then return.
3. [Replace data](#) with *node*, *node*'s [data](#)'s [length](#), 0, and *next*'s [data](#).
4. If *next*'s parent is non-null, then [remove](#) *next*.

The parent check is necessary as the previous step might have triggered mutation events.

3.2.8 Requirements relating to the bidirectional algorithm

3.2.8.1 Authoring conformance criteria for bidirectional-algorithm formatting characters

[Text content](#) in [HTML elements](#) with [Text](#) nodes in their [contents](#), and text in attributes of [HTML elements](#) that allow free-form text, may contain characters in the ranges U+202A to U+202E and U+2066 to U+2069 (the bidirectional-algorithm formatting characters). [\[BIDI\]](#)

Authors are encouraged to use the [dir](#) attribute, the [bdo](#) element, and the [bdi](#) element, rather than maintaining the bidirectional-algorithm formatting characters manually. The bidirectional-algorithm formatting characters interact poorly with CSS.

3.2.8.2 User agent conformance criteria

User agents must implement the Unicode bidirectional algorithm to determine the proper ordering of characters when rendering documents and parts of documents. [\[BIDI\]](#)

The mapping of HTML to the Unicode bidirectional algorithm must be done in one of three ways. Either the user agent must implement CSS, including in particular the CSS '[unicode-bidi](#)', '[direction](#)', and '[content](#)' properties, and must have, in its user agent style sheet, the rules using those properties given in this specification's [rendering](#) section, or, alternatively, the user agent must act as if it implemented just the aforementioned properties and had a user agent style sheet that included all the aforementioned rules, but without letting style sheets specified in documents override them, or, alternatively, the user agent must implement another styling language with equivalent semantics. [\[CSSGC\]](#)

The following elements and attributes have requirements defined by the [rendering](#) section that, due to the requirements in this section, are requirements on all user agents (not just those that [support the suggested default rendering](#)):

- [dir](#) attribute
- [bdi](#) element
- [bdo](#) element
- [br](#) element
- [pre](#) element
- [textarea](#) element
- [wbr](#) element

3.2.9 Requirements related to ARIA and to platform accessibility APIs

User agent requirements for implementing Accessibility API semantics on [HTML elements](#) are defined in *HTML Accessibility API Mappings*. In addition to the rules there, for a [custom element](#) element, the default ARIA role semantics are determined as follows: [\[HTMLAAM\]](#)

1. Let *map* be *element*'s [native accessibility semantics map](#).

2. If `map["role"]` exists, then return it.

3. Return no role.

Similarly, for a [custom element](#) element, the default ARIA state and property semantics, for a state or property named `stateOrProperty`, are determined as follows:

1. Let `map` be `element's native accessibility semantics map`.

2. If `map[stateOrProperty]` exists, then return it.

3. Return the default value for `stateOrProperty`.

The "default semantics" referred to here are sometimes also called "native", "implicit", or "host language" semantics in ARIA. [\[ARIA\]](#)

One implication of these definitions is that the default semantics can change over time. This allows custom elements the same expressivity as built-in elements; e.g., compare to how the default ARIA role semantics of an `a` element change as the `href` attribute is added or removed.

For an example of this in action, see [the custom elements section](#).

Conformance checker requirements for checking use of ARIA `role` and `aria-*` attributes on [HTML elements](#) are defined in *ARIA in HTML*. [\[ARIAHTML\]](#)

4 The elements of HTML

4.1 The document element

4.1.1 The `html` element



[Element/html](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLHtmlElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As document's [document](#) element.

Wherever a subdocument fragment is allowed in a compound document.

[Content model:](#)

A [head](#) element followed by a [body](#) element.

[Tag omission in text/html:](#)

An [html](#) element's [start tag](#) can be omitted if the first thing inside the [html](#) element is not a [comment](#).

An [html](#) element's [end tag](#) can be omitted if the [html](#) element is not immediately followed by a [comment](#).

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLHtmlElement : HTMLElement {
  [HTMLConstructor] constructor();
  // also has obsolete members
};
```

The [html](#) element [represents](#) the root of an HTML document.

Authors are encouraged to specify a [lang](#) attribute on the root [html](#) element, giving the document's language. This aids speech synthesis tools to determine what pronunciations to use,

translation tools to determine what rules to use, and so forth.

The [html](#) element in the following example declares that the document's language is English.

```
<!DOCTYPE html>
<html lang="en">
<head>
<title>Swapping Songs</title>
</head>
<body>
<h1>Swapping Songs</h1>
<p>Tonight I swapped some of the songs I wrote with some friends, who
gave me some of the songs they wrote. I love sharing my music.</p>
</body>
</html>
```

4.2 Document metadata

4.2.1 The **head** element



[Element/head](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLHeadElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

Contexts in which this element can be used:

As the first element in an [html](#) element.

Content model:

If the document is [an iframe srcdoc document](#) or if title information is available from a higher-level protocol: Zero or more elements of [metadata content](#), of which no more than one is a [title](#) element and no more than one is a [base](#) element.

Otherwise: One or more elements of [metadata content](#), of which exactly one is a [title](#) element and no more than one is a [base](#) element.

Tag omission in text/html:

A [head](#) element's [start tag](#) can be omitted if the element is empty, or if the first thing inside the [head](#) element is an element.

A [head](#) element's [end tag](#) can be omitted if the [head](#) element is not immediately followed by [ASCII whitespace](#) or a [comment](#).

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLHeadElement : HTMLElement {
    [HTMLConstructor] constructor();
};
```

The [head](#) element [represents](#) a collection of metadata for the [Document](#).

The collection of metadata in a [head](#) element can be large or small. Here is an example of a very short one:

```
<!doctype html>
<html lang=en>
<head>
    <title>A document with a short head</title>
</head>
<body>
    ...
```

Here is an example of a longer one:

```
<!DOCTYPE HTML>
<HTML LANG="EN">
<HEAD>
  <META CHARSET="UTF-8">
  <BASE HREF="https://www.example.com/">
  <TITLE>An application with a long head</TITLE>
  <LINK REL="STYLESHEET" HREF="default.css">
  <LINK REL="STYLESHEET ALTERNATE" HREF="big.css" TITLE="Big Text">
  <SCRIPT SRC="support.js"></SCRIPT>
  <META NAME="APPLICATION-NAME" CONTENT="Long headed application">
</HEAD>
<BODY>
  ...

```

The [title](#) element is a required child in most situations, but when a higher-level protocol provides title information, e.g. in the Subject line of an email when HTML is used as an email authoring format, the [title](#) element can be omitted.

4.2.2 The **title** element



[Element/title](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 1+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLTitleElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Metadata content](#).

Contexts in which this element can be used:

In a [head](#) element containing no other [title](#) elements.

Content model:

[Text](#) that is not [inter-element whitespace](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLOutputElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute DOMString text;
};
```

The [title](#) element [represents](#) the document's title or name. Authors should use titles that identify their documents even when they are used out of context, for example in a user's history or bookmarks, or in search results. The document's title is often different from its first heading, since the first heading does not have to stand alone when taken out of context.

There must be no more than one [title](#) element per document.

If it's reasonable for the [Document](#) to have no title, then the [title](#) element is probably not required. See the [head](#) element's content model for a description of when the element is required.

`title.text [= value]`

Returns the [child text content](#) of the element.

Can be set, to replace the element's children with the given value.

The `text` attribute's getter must return this [title](#) element's [child text content](#).

The `text` attribute's setter must [string replace all](#) with the given value within this [title](#) element.

Here are some examples of appropriate titles, contrasted with the top-level headings that might be used on those same pages.

```
<title>Introduction to The Mating Rituals of Bees</title>
...
<h1>Introduction</h1>
<p>This companion guide to the highly successful
<cite>Introduction to Medieval Bee-Keeping</cite> book is...
```

The next page might be a part of the same site. Note how the title describes the subject matter unambiguously, while the first heading assumes the reader knows what the context is and therefore won't wonder if the dances are Salsa or Waltz:

```
<title>Dances used during bee mating rituals</title>
...
<h1>The Dances</h1>
```

The string to use as the document's title is given by the [document.title](#) IDL attribute.

User agents should use the document's title when referring to the document in their user interface. When the contents of a [title](#) element are used in this way, [the directionality](#) of that [title](#) element should be used to set the directionality of the document's title in the user interface.

4.2.3 The **base** element



[Element/base](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLBaseElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Categories:

[Metadata content.](#)

Contexts in which this element can be used:

In a [head](#) element containing no other [base](#) elements.

Content model:

[Nothing.](#)

Tag omission in text/html:

No [end tag](#).

Content attributes:

[Global attributes](#)

[href](#) — [Document base URL](#)

[target](#) — Default [browsing context](#) for [hyperlink navigation](#) and [form submission](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLBaseElement : HTMLElement {
  HTMLConstructor constructor();
  CEReactions attribute USVString href;
  CEReactions attribute DOMString target;
};
```

The [base](#) element allows authors to specify the [document base URL](#) for the purposes of [parsing URLs](#), and the name of the default [browsing context](#) for the purposes of [following hyperlinks](#). The element does not [represent](#) any content beyond this information.

There must be no more than one [base](#) element per document.

A [base](#) element must have either an [href](#) attribute, a [target](#) attribute, or both.

The [href](#) content attribute, if specified, must contain a [valid URL potentially surrounded by spaces](#).

A [base](#) element, if it has an [href](#) attribute, must come before any other elements in the tree

that have attributes defined as taking [URLs](#), except the [html](#) element (its [manifest](#) attribute isn't affected by [base](#) elements).

If there are multiple [base](#) elements with [href](#) attributes, all but the first are ignored.

The [target](#) attribute, if specified, must contain a [valid browsing context name or keyword](#), which specifies which [browsing context](#) is to be used as the default when [hyperlinks](#) and [forms](#) in the [Document](#) cause [navigation](#).

A [base](#) element, if it has a [target](#) attribute, must come before any elements in the tree that represent [hyperlinks](#).

If there are multiple [base](#) elements with [target](#) attributes, all but the first are ignored.

To get an element's target, given an [a](#), [area](#), or [form](#) element *element*, run these steps:

1. If *element* has a [target](#) attribute, then return that attribute's value.
 2. If *element*'s [node document](#) contains a [base](#) element with a [target](#) attribute, then return the value of the [target](#) attribute of the first such [base](#) element.
 3. Return the empty string.
-

A [base](#) element that is the first [base](#) element with an [href](#) content attribute [in a document tree](#) has a [frozen base URL](#). The [frozen base URL](#) must be [immediately set](#) for an element whenever any of the following situations occur:

- The [base](#) element becomes the first [base](#) element in [tree order](#) with an [href](#) content attribute in its [Document](#).
- The [base](#) element is the first [base](#) element in [tree order](#) with an [href](#) content attribute in its [Document](#), and its [href](#) content attribute is changed.

To set the [frozen base URL](#) for an element *element*:

1. Let *document* be *element*'s [node document](#).
2. Let *urlRecord* be the result of [parsing](#) the value of *element*'s [href](#) content attribute with *document*'s [fallback base URL](#), and *document*'s [character encoding](#). (Thus, the [base](#) element isn't affected by itself.)
3. Set *element*'s [frozen base URL](#) to *document*'s [fallback base URL](#), if *urlRecord* is failure or running [Is base allowed for Document?](#) on the [resulting URL record](#) and *document* returns "Blocked", and to *urlRecord* otherwise.

The [href](#) IDL attribute, on getting, must return the result of running the following algorithm:

1. Let *document* be *element*'s [node document](#).
2. Let *url* be the value of the [href](#) attribute of this element, if it has one, and the empty string otherwise.
3. Let *urlRecord* be the result of [parsing url](#) with *document*'s [fallback base URL](#), and *document*'s [character encoding](#). (Thus, the [base](#) element isn't affected by other [base](#) elements or itself.)
4. If *urlRecord* is failure, return *url*.
5. Return the [serialization](#) of *urlRecord*.

The [href](#) IDL attribute, on setting, must set the [href](#) content attribute to the given new value.

The [target](#) IDL attribute must [reflect](#) the content attribute of the same name.

In this example, a [base](#) element is used to set the [document base URL](#):

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <title>This is an example for the &lt;base&gt; element</title>
    <base href="https://www.example.com/news/index.html">
  </head>
  <body>
    <p>Visit the <a href="archives.html">archives</a>.</p>
  </body>
</html>
```

The link in the above example would be a link to "<https://www.example.com/news/archives.html>".

4.2.4 The **link** element



[Element/link](#)

Support in all current engines.

Firefox 1+ | Safari Yes | Chrome 1+

Opera Yes | Edge 79+

Edge (Legacy) 12+ | Internet Explorer Yes

Firefox Android 4+ | Safari iOS Yes | Chrome Android Yes | WebView Android Yes | Samsung Internet Yes | Opera Android Yes

[HTMLLinkElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Metadata content](#).

If the element is [allowed in the body](#): [flow content](#).

If the element is [allowed in the body](#): [phrasing content](#).

[Contexts in which this element can be used:](#)

Where [metadata content](#) is expected.

In a [noscript](#) element that is a child of a [head](#) element.

If the element is [allowed in the body](#): where [phrasing content](#) is expected.

[Content model:](#)

[Nothing](#).

[Tag omission in text/html:](#)

No [end tag](#).

[Content attributes:](#)

[Global attributes](#)

[href](#) — Address of the [hyperlink](#)

[crossorigin](#) — How the element handles crossorigin requests

[rel](#) — Relationship between the document containing the [hyperlink](#) and the destination resource

[media](#) — Applicable media

[integrity](#) — Integrity metadata used in *Subresource Integrity* checks [[SRI](#)]

[hreflang](#) — Language of the linked resource

[type](#) — Hint for the type of the referenced resource

[referrerpolicy](#) — Referrer policy for fetches initiated by the element

[sizes](#) — Sizes of the icons (for [rel="icon"](#))

[imagesrcset](#) — Images to use in different situations, e.g., high-resolution displays, small monitors, etc. (for [rel="preload"](#))

[imagesizes](#) — Image sizes for different page layouts (for [rel="preload"](#))

[as](#) — Potential destination for a preload request (for [rel="preload"](#) and [rel="modulepreload"](#))

[color](#) — Color to use when customizing a site's icon (for [rel="mask-icon"](#))

[disabled](#) — Whether the link is disabled

Also, the [title](#) attribute [has special semantics](#) on this element: Title of the link; [CSS style sheet set name](#).

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLLinkElement : HTMLElement {
    [HTMLConstructor] constructor();

    [CEReactions] attribute USVString href;
    [CEReactions] attribute DOMString? crossOrigin;
    [CEReactions] attribute DOMString rel;
    [CEReactions] attribute DOMString as; // (default "")
    [SameObject, PutForwards=value] readonly attribute DOMTokenList relList;
    [CEReactions] attribute DOMString media;
    [CEReactions] attribute DOMString integrity;
    [CEReactions] attribute DOMString hreflang;
    [CEReactions] attribute DOMString type;
    [SameObject, PutForwards=value] readonly attribute DOMTokenList sizes;
    [CEReactions] attribute USVString imageSrcset;
    [CEReactions] attribute DOMString imageSizes;
    [CEReactions] attribute DOMString referrerPolicy;
    [CEReactions] attribute boolean disabled;

    // also has obsolete members
};

HTMLLinkElement includes LinkStyle;
```

The [link](#) element allows authors to link their document to other resources.

The address of the link(s) is given by the [href](#) attribute. If the [href](#) attribute is present, then its value must be a [valid non-empty URL potentially surrounded by spaces](#). One or both of the [href](#) or [imagesrcset](#) attributes must be present.

If both the [href](#) and [imagesrcset](#) attributes are absent, then the element does not define a link.

The types of link indicated (the relationships) are given by the value of the [rel](#) attribute, which, if present, must have a value that is a [unordered set of unique space-separated tokens](#). The [allowed keywords and their meanings](#) are defined in a later section. If the [rel](#) attribute is absent, has no keywords, or if none of the keywords used are allowed according to the definitions in this specification, then the element does not create any links.

[rel's supported tokens](#) are the keywords defined in [HTML link types](#) which are allowed on [link](#) elements, impact the processing model, and are supported by the user agent. The possible [supported tokens](#) are [alternate](#), [dns-prefetch](#), [icon](#), [manifest](#), [modulepreload](#), [next](#), [pingback](#), [preconnect](#), [prefetch](#), [preload](#), [prerender](#), [search](#), and [stylesheet](#). [rel's supported tokens](#) must only include the tokens from this list that the user agent implements the processing model for.

Theoretically a user agent could support the processing model for the [canonical](#) keyword — if it were a search engine that executed JavaScript. But in practice that's quite unlikely. So in most cases, [canonical](#) ought not be included in [rel's supported tokens](#).

A [link](#) element must have either a [rel](#) attribute or an [itemprop](#) attribute, but not both.

If a [link](#) element has an [itemprop](#) attribute, or has a [rel](#) attribute that contains only keywords that are [body-ok](#), then the element is said to be *allowed in the body*. This means that the element can be used where [phrasing content](#) is expected.

If the [rel](#) attribute is used, the element can only sometimes be used in the [body](#) of the page. When used with the [itemprop](#) attribute, the element can be used both in the [head](#) element and in the [body](#) of the page, subject to the constraints of the microdata model.

Two categories of links can be created using the [link](#) element: [links to external resources](#) and [hyperlinks](#). The [link types section](#) defines whether a particular link type is an external resource or a hyperlink. One [link](#) element can create multiple links (of which some might be [external resource links](#) and some might be [hyperlinks](#)); exactly which and how many links are created depends on the keywords given in the [rel](#) attribute. User agents must process the links on a per-link basis, not a per-element basis.

Each link created for a [link](#) element is handled separately. For instance, if there are two [link](#) elements with `rel="stylesheet"`, they each count as a separate external resource, and each is affected by its own attributes independently. Similarly, if a single [link](#) element has a [rel](#)

attribute with the value `next stylesheet`, it creates both a [hyperlink](#) (for the `next` keyword) and an [external resource link](#) (for the `stylesheet` keyword), and they are affected by other attributes (such as `media` or `title`) differently.

For example, the following [`link`](#) element creates two [hyperlinks](#) (to the same page):

```
<link rel="author license" href="/about">
```

The two links created by this element are one whose semantic is that the target page has information about the current page's author, and one whose semantic is that the target page has information regarding the license under which the current page is provided.

[Hyperlinks](#) created with the [`link`](#) element and its `rel` attribute apply to the whole document. This contrasts with the `rel` attribute of [`a`](#) and [`area`](#) elements, which indicates the type of a link whose context is given by the link's location within the document.

Unlike those created by [`a`](#) and [`area`](#) elements, [hyperlinks](#) created by [`link`](#) elements are not displayed as part of the document by default, in user agents that [support the suggested default rendering](#). And even if they are force-displayed using CSS, they have no [activation behavior](#). Instead, they primarily provide semantic information which might be used by the page or by other software that consumes the page's contents. Additionally, the user agent can [provide its own UI for following such hyperlinks](#).

The exact behavior for [links to external resources](#) depends on the exact relationship, as defined for the relevant [link type](#).

The `crossorigin` attribute is a [CORS settings attribute](#). It is intended for use with [external resource links](#).

The `media` attribute says which media the resource applies to. The value must be a [valid media query list](#).

The `integrity` attribute represents the [integrity metadata](#) for requests which this element is responsible for. The value is text. The attribute must only be specified on [`link`](#) elements that have a `rel` attribute that contains the `stylesheet`, `preload`, or `modulepreload` keyword. [\[SRI\]](#)

The `hreflang` attribute on the [`link`](#) element has the same semantics as the [`hreflang` attribute on the `a` element](#).

The `type` attribute gives the [MIME type](#) of the linked resource. It is purely advisory. The value must be a [valid MIME type string](#).

For [external resource links](#), the `type` attribute is used as a hint to user agents so that they can avoid fetching resources they do not support.

The `referrerpolicy` attribute is a [referrer policy attribute](#). It is intended for use with [external resource links](#), where it helps set the [referrer policy](#) used when [fetching and processing the linked resource](#). [\[REFERRERPOLICY\]](#).

The `title` attribute gives the title of the link. With one exception, it is purely advisory. The value is text. The exception is for style sheet links that are [in a document tree](#), for which the `title` attribute defines [CSS style sheet sets](#).

The `title` attribute on [link](#) elements differs from the global `title` attribute of most other elements in that a link without a title does not inherit the title of the parent element: it merely has no title.

The `imagesrcset` attribute may be present, and is a [srcset attribute](#).

The `imagesrcset` and `href` attributes (if [width descriptors](#) are not used) together contribute the [image sources](#) to the [source set](#).

If the `imagesrcset` attribute is present and has any [image candidate strings](#) using a [width descriptor](#), the `imagesizes` attribute must also be present, and is a [sizes attribute](#). The `imagesizes` attribute contributes the [source size](#) to the [source set](#).

The `imagesrcset` and `imagesizes` attributes must only be specified on [link](#) elements that have both a `rel` attribute that specifies the `preload` keyword, as well as an `as` attribute in the "image" state.

These attributes allow preloading the appropriate resource that is later used by an [img](#) element that has the corresponding values for its `srcset` and `sizes` attributes:

```
<link rel="preload" as="image"
      imagesrcset="wolf_400px.jpg 400w, wolf_800px.jpg 800w, wolf_1600px.jpg 1600w"
      imagesizes="50vw">

<!-- ... later, or perhaps inserted dynamically ... -->

```

Note how we omit the `href` attribute, as it would only be relevant for browsers that do not support `imagesrcset`, and in those cases it would likely cause the incorrect image to be preloaded.

The `imagesrcset` attribute can be combined with the `media` attribute to preload the appropriate resource selected from a [picture](#) element's sources, for [art direction](#):

```
<link rel="preload" as="image"
      imagesrcset="dog-cropped-1x.jpg, dog-cropped-2x.jpg 2x"
```

```
media="(max-width: 800px)">
<link rel="preload" as="image"
      imagesrcset="dog-wide-1x.jpg, dog-wide-2x.jpg 2x"
      media="(min-width: 801px)">

<!-- ... later, or perhaps inserted dynamically ... -->
<picture>
  <source srcset="dog-cropped-1x.jpg, dog-cropped-2x.jpg 2x"
          media="(max-width: 800px)">
  
</picture>
```

The **sizes** attribute gives the sizes of icons for visual media. Its value, if present, is merely advisory. User agents may use the value to decide which icon(s) to use if multiple icons are available. If specified, the attribute must have a value that is an [unordered set of unique space-separated tokens](#) which are [ASCII case-insensitive](#). Each value must be either an [ASCII case-insensitive](#) match for the string "[any](#)", or a value that consists of two [valid non-negative integers](#) that do not have a leading U+0030 DIGIT ZERO (0) character and that are separated by a single U+0078 LATIN SMALL LETTER X or U+0058 LATIN CAPITAL LETTER X character. The attribute must only be specified on [link](#) elements that have a [rel](#) attribute that specifies the [icon](#) keyword or the [apple-touch-icon](#) keyword.

The [apple-touch-icon](#) keyword is a registered [extension to the predefined set of link types](#), but user agents are not required to support it in any way.

The **as** attribute specifies the [potential destination](#) for a preload request for the resource given by the [href](#) attribute. It is an [enumerated attribute](#). Each [potential destination](#) is a keyword for this attribute, mapping to a state of the same name. The attribute must be specified on [link](#) elements that have a [rel](#) attribute that contains the [preload](#) keyword. It may be specified on [Link](#) elements that have a [rel](#) attribute that contains the [modulepreload](#) keyword; in such cases it must have a value which is a [script-like destination](#). For other [link](#) elements, it must not be specified.

The processing model for how the **as** attribute is used is given in an individual link type's [fetch and process the linked resource](#) algorithm.

The attribute does not have a [missing value default](#) or [invalid value default](#), meaning that invalid or missing values for the attribute map to no state. This is accounted for in the processing model. For [preload](#) links, both conditions are an error; for [modulepreload](#) links, a missing value will be treated as "script".

The **color** attribute is used with the **mask-icon** link type. The attribute must only be specified on [link](#) elements that have a [rel](#) attribute that contains the [mask-icon](#) keyword.

The value must be a string that matches the CSS `<color>` production, defining a suggested color that user agents can use to customize the display of the icon that the user sees when they pin your site.

This specification does not have any user agent requirements for the `color` attribute.

The `mask-icon` keyword is a registered [extension to the predefined set of link types](#), but user agents are not required to support it in any way.

`link` elements have an associated *explicitly enabled* boolean. It is initially false.

The `disabled` attribute is a [boolean attribute](#) that is used with the `stylesheet` link type. The attribute must only be specified on `link` elements that have a `rel` attribute that contains the `stylesheet` keyword.

Whenever the `disabled` attribute is removed, set the `link` element's [*explicitly enabled*](#) attribute to true.

Removing the `disabled` attribute dynamically, e.g., using `document.querySelector("link").removeAttribute("disabled")`, will fetch and apply the style sheet:

```
<link disabled rel="alternate stylesheet" href="css/pooh">
```

✓MDN

[HTMLLinkElement/rel](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The IDL attributes `href`, `hreflang`, `integrity`, `media`, `rel`, `sizes`, `type`, and `disabled` each must [reflect](#) the respective content attributes of the same name.

There is no reflecting IDL attribute for the `color` attribute, but this might be added later.

✓MDN

[HTMLLinkElement/as](#)

Support in all current engines.

Firefox 56+ Safari 10+ Chrome 50+

Opera 37+ Edge 79+

Edge (Legacy) 17+ Internet Explorer No

Firefox Android 56+ Safari iOS 10+ Chrome Android 50+ WebView Android 50+ Samsung

Internet 5.0+ Opera Android 37+

The `as` IDL attribute must [reflect](#) the `as` content attribute, [limited to only known values](#).

The `crossOrigin` IDL attribute must [reflect](#) the `crossorigin` content attribute, [limited to only known values](#).



[HTMLLinkElement/referrerPolicy](#)

Support in all current engines.

Firefox 50+ Safari 14.1+ Chrome 58+

Opera 45+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 50+ Safari iOS 14.5+ Chrome Android 58+ WebView Android 58+ Samsung

Internet 7.0+ Opera Android 43+

The `referrerPolicy` IDL attribute must [reflect](#) the `referrerpolicy` content attribute, [limited to only known values](#).

The `imageSrcset` IDL attribute must [reflect](#) the `imagesrcset` content attribute.

The `imageSizes` IDL attribute must [reflect](#) the `imagesizes` content attribute.



[HTMLLinkElement/relList](#)

Support in all current engines.

Firefox 30+ Safari 9+ Chrome 50+

Opera 37+ Edge 79+

Edge (Legacy) 17+ Internet Explorer No

Firefox Android 30+ Safari iOS 9+ Chrome Android 50+ WebView Android 50+ Samsung

Internet 5.0+ Opera Android 37+

The `relList` IDL attribute must [reflect](#) the `rel` content attribute.

4.2.4.1 Processing the `media` attribute

If the link is a [hyperlink](#) then the `media` attribute is purely advisory, and describes for which media the document in question was designed.

However, if the link is an [external resource link](#), then the `media` attribute is prescriptive. The user agent must apply the external resource when the `media` attribute's value [matches the environment](#) and the other relevant conditions apply, and must not apply it otherwise.

The default, if the `media` attribute is omitted, is "`all`", meaning that by default links apply to all media.

The external resource might have further restrictions defined within that limit its applicability. For example, a CSS style sheet might have some `@media` blocks. This specification does not override such further restrictions or requirements.

4.2.4.2 Processing the `type` attribute

If the `type` attribute is present, then the user agent must assume that the resource is of the given type (even if that is not a [valid MIME type string](#), e.g. the empty string). If the attribute is omitted, but the [external resource link](#) type has a default type defined, then the user agent must assume that the resource is of that type. If the UA does not support the given [MIME type](#) for the given link relationship, then the UA should not [fetch and process the linked resource](#); if the UA does support the given [MIME type](#) for the given link relationship, then the UA should [fetch and process the linked resource](#) at the appropriate time as specified for the [external resource link](#)'s particular type. If the attribute is omitted, and the [external resource link](#) type does not have a default type defined, but the user agent would [fetch and process the linked resource](#) if the type was known and supported, then the user agent should [fetch and process the linked resource](#) under the assumption that it will be supported.

User agents must not consider the `type` attribute authoritative — upon fetching the resource, user agents must not use the `type` attribute to determine its actual type. Only the actual type (as defined in the next paragraph) is used to determine whether to *apply* the resource, not the aforementioned assumed type.

If the [external resource link](#) type defines rules for processing the resource's [Content-Type metadata](#), then those rules apply. Otherwise, if the resource is expected to be an image, user agents may apply the [image sniffing rules](#), with the *official* type being the type determined from the resource's [Content-Type metadata](#), and use the resulting [computed type of the resource](#) as if it was the actual type. Otherwise, if neither of these conditions apply or if the user agent opts not to apply the image sniffing rules, then the user agent must use the resource's [Content-Type metadata](#) to determine the type of the resource. If there is no type metadata, but the [external resource link](#) type has a default type defined, then the user agent must assume that the resource is of that type.

The [stylesheet](#) link type defines rules for processing the resource's [Content-Type metadata](#).

Once the user agent has established the type of the resource, the user agent must apply the resource if it is of a supported type and the other relevant conditions apply, and must ignore the resource otherwise.

If a document contains style sheet links labeled as follows:

```
<link rel="stylesheet" href="A" type="text/plain">
<link rel="stylesheet" href="B" type="text/css">
<link rel="stylesheet" href="C">
```

...then a compliant UA that supported only CSS style sheets would fetch the B and C files, and skip the A file (since [text/plain](#) is not the [MIME type](#) for CSS style sheets).

For files B and C, it would then check the actual types returned by the server. For those that are sent as [text/css](#), it would apply the styles, but for those labeled as [text/plain](#), or any other type, it would not.

If one of the two files was returned without a [Content-Type](#) metadata, or with a syntactically incorrect type like [Content-Type: "null"](#), then the default type for [stylesheet](#) links would kick in. Since that default type is [text/css](#), the style sheet would nonetheless be applied.

4.2.4.3 Fetching and processing a resource from a [Link](#) element

All [external resource links](#) have a *fetch and process the linked resource* algorithm, which takes a [link](#) element *el*. They also have *linked resource fetch setup steps* which take a [link](#) element *el* and [request](#) *request*. Individual link types may provide their own [fetch and process the linked resource](#) algorithm, but unless explicitly stated, they use the [default fetch and process the linked resource](#) algorithm. Similarly, individual link types may provide their own [linked resource fetch setup steps](#), but unless explicitly stated, these steps just return true.

The *default fetch and process the linked resource*, given a [link](#) element *el*, is as follows:

1. If *el*'s [href](#) attribute's value is the empty string, then return.
2. [Parse a URL](#) given *el*'s [href](#) attribute, relative to *el*'s [node document](#). If that fails, then return. Otherwise, let *url* be the [resulting URL record](#).
3. Let *corsAttributeState* be the current state of *el*'s [crossorigin](#) content attribute.
4. Let *request* be the result of [creating a potential-CORS request](#) given *url*, the empty string, and *corsAttributeState*.
5. Set *request*'s [synchronous flag](#).
6. Set *request*'s [client](#) to *el*'s [node document](#)'s [relevant settings object](#).

7. Set *request*'s [cryptographic nonce metadata](#) to the current value of *el*'s [\[\[CryptographicNonce\]\]](#) internal slot.
8. Set *request*'s [integrity metadata](#) to the current value of *el*'s [integrity](#) content attribute.
9. Set *request*'s [referrer policy](#) to the current state of *el*'s [referrerpolicy](#) attribute.
10. Run the [linked resource fetch setup steps](#), given *el* and *request*. If the result is false, then return.
11. Run the following steps [in parallel](#):

1. Let *response* be the result of [fetching](#) *request*.
2. Let *success* be true.
3. If *response* is a [network error](#) or its [status](#) is not an [ok status](#), set *success* to false.

Note that content-specific errors, e.g., CSS parse errors or PNG decoding errors, do not affect *success*.

4. If *success* is true, wait for the [link resource](#)'s [critical subresources](#) to finish loading.

The specification that defines a link type's [critical subresources](#) (e.g., CSS) is expected to describe how these subresources are fetched and processed.

However, since this is not currently explicit, this specification describes waiting for a [link resource](#)'s [critical subresources](#) to be fetched and processed, with the expectation that this will be done correctly.

5. [Queue an element task](#) on the [networking task source](#) given *el* to [process the linked resource](#) given *el*, *success*, and *response*.

User agents may opt to only try to [fetch and process](#) such resources when they are needed, instead of pro-actively fetching all the [external resources](#) that are not applied.

Similar to the [fetch and process the linked resource](#) algorithm, all [external resource links](#) have a [process the linked resource](#) algorithm which takes a [link](#) element *el*, boolean *success*, and [response](#) *response*. Individual link types may provide their own [process the linked resource](#) algorithm, but unless explicitly stated, that algorithm does nothing.

Unless otherwise specified for a given [rel](#) keyword, the element must [delay the load event](#) of the element's [node document](#) until all the attempts to [fetch and process the linked resource](#) and its [critical subresources](#) are complete. (Resources that the user agent has not yet attempted to fetch and process, e.g., because it is waiting for the resource to be needed, do not [delay the load event](#).)

4.2.4.4 Processing '[Link](#)' headers

HTTP '[Link](#)' headers, if supported, must be assumed to come before any links in the document, in the order that they were given in the HTTP message. These headers are to be processed according to the rules given in the relevant specifications. [\[HTTP\]](#) [\[WEBLINK\]](#)

Registration of relation types in HTTP '[Link](#)' headers is distinct from [HTML link types](#), and thus their semantics can be different from same-named HTML types.

The processing of '[Link](#)' headers, in particular their influence on a [Document](#)'s [script-blocking style sheet counter](#), is not defined. See [issue #4224](#) for discussion on integrating this into the spec.

4.2.4.5 Providing users with a means to follow hyperlinks created using the [Link](#) element

Interactive user agents may provide users with a means to [follow the hyperlinks](#) created using the [link](#) element, somewhere within their user interface. The exact interface is not defined by this specification, but it could include the following information (obtained from the element's attributes, again as defined below), in some form or another (possibly simplified), for each [hyperlink](#) created with each [link](#) element in the document:

- The relationship between this document and the resource (given by the [rel](#) attribute).
- The title of the resource (given by the [title](#) attribute).
- The address of the resource (given by the [href](#) attribute).
- The language of the resource (given by the [hreflang](#) attribute).
- The optimum media for the resource (given by the [media](#) attribute).

User agents could also include other information, such as the type of the resource (as given by the [type](#) attribute).

4.2.5 The [meta](#) element



[Element/meta](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLMetaElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Metadata content](#).

If the [itemprop](#) attribute is present: [flow content](#).

If the [itemprop](#) attribute is present: [phrasing content](#).

[Contexts in which this element can be used:](#)

If the [charset](#) attribute is present, or if the element's [http-equiv](#) attribute is in the [Encoding declaration state](#): in a [head](#) element.

If the [http-equiv](#) attribute is present but not in the [Encoding declaration state](#): in a [head](#) element.

If the [http-equiv](#) attribute is present but not in the [Encoding declaration state](#): in a [noscript](#) element that is a child of a [head](#) element.

If the [name](#) attribute is present: where [metadata content](#) is expected.

If the [itemprop](#) attribute is present: where [metadata content](#) is expected.

If the [itemprop](#) attribute is present: where [phrasing content](#) is expected.

[Content model:](#)

[Nothing](#).

[Tag omission in text/html:](#)

No [end tag](#).

[Content attributes:](#)

[Global attributes](#)

[name](#) — Metadata name

[http-equiv](#) — Pragma directive

[content](#) — Value of the element

[charset](#) — [Character encoding declaration](#)

[media](#) — Applicable media

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLMetaElement : HTMLElement {
  HTMLConstructor constructor();

  CEReactions attribute DOMString name;
  CEReactions attribute DOMString httpEquiv;
  CEReactions attribute DOMString content;
  CEReactions attribute DOMString media;

  // also has obsolete members
};
```

The [meta](#) element [represents](#) various kinds of metadata that cannot be expressed using the [title](#), [base](#), [link](#), [style](#), and [script](#) elements.

The [meta](#) element can represent document-level metadata with the [name](#) attribute, pragma directives with the [http-equiv](#) attribute, and the file's [character encoding declaration](#) when an HTML document is serialized to string form (e.g. for transmission over the network or for disk storage) with the [charset](#) attribute.

Exactly one of the [name](#), [http-equiv](#), [charset](#), and [itemprop](#) attributes must be specified.

If either [name](#), [http-equiv](#), or [itemprop](#) is specified, then the [content](#) attribute must also be specified. Otherwise, it must be omitted.

The [charset](#) attribute specifies the [character encoding](#) used by the document. This is a [character encoding declaration](#). If the attribute is present, its value must be an [ASCII case-insensitive](#) match for the string "[utf-8](#)".

The [charset](#) attribute on the [meta](#) element has no effect in XML documents, but is allowed in XML documents in order to facilitate migration to and from XML.

There must not be more than one [meta](#) element with a [charset](#) attribute per document.

The [content](#) attribute gives the value of the document metadata or pragma directive when the element is used for those purposes. The allowed values depend on the exact context, as described in subsequent sections of this specification.

If a [meta](#) element has a [name](#) attribute, it sets document metadata. Document metadata is

expressed in terms of name-value pairs, the [name](#) attribute on the [meta](#) element giving the name, and the [content](#) attribute on the same element giving the value. The name specifies what aspect of metadata is being set; valid names and the meaning of their values are described in the following sections. If a [meta](#) element has no [content](#) attribute, then the value part of the metadata name-value pair is the empty string.

The [media](#) attribute says which media the metadata applies to. The value must be a [valid media query list](#). Unless the [name](#) is [theme-color](#), the [media](#) attribute has no effect on the processing model and must not be used by authors.

The [name](#), [content](#), and [media](#) IDL attributes must [reflect](#) the respective content attributes of the same name. The IDL attribute [httpEquiv](#) must [reflect](#) the content attribute [http-equiv](#).

4.2.5.1 Standard metadata names



[Element/meta/name](#)

Support in all current engines.

Firefox 1+ Safari 4+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

This specification defines a few names for the [name](#) attribute of the [meta](#) element.

Names are case-insensitive, and must be compared in an [ASCII case-insensitive](#) manner.

[application-name](#)

The value must be a short free-form string giving the name of the web application that the page represents. If the page is not a web application, the [application-name](#) metadata name must not be used. Translations of the web application's name may be given, using the [lang](#) attribute to specify the language of each name.

There must not be more than one [meta](#) element with a given [language](#) and where the [name](#) attribute value is an [ASCII case-insensitive](#) match for [application-name](#) per document.

User agents may use the application name in UI in preference to the page's [title](#), since the title might include status messages and the like relevant to the status of the page at a particular moment in time instead of just being the name of the application.

To find the application name to use given an ordered list of languages (e.g. British English, American English, and English), user agents must run the following steps:

1. Let *languages* be the list of languages.
 2. Let *default language* be the [language](#) of the [Document](#)'s [document element](#), if any, and if that language is not unknown.
 3. If there is a *default language*, and if it is not the same language as any of the languages in *languages*, append it to *languages*.
 4. Let *winning language* be the first language in *languages* for which there is a [meta](#) element in the [Document](#) where the [name](#) attribute value is an [ASCII case-insensitive](#) match for [application-name](#) and whose [language](#) is the language in question.
- If none of the languages have such a [meta](#) element, then return; there's no given application name.
5. Return the value of the [content](#) attribute of the first [meta](#) element in the [Document](#) in [tree order](#) where the [name](#) attribute value is an [ASCII case-insensitive](#) match for [application-name](#) and whose [language](#) is *winning language*.

This algorithm would be used by a browser when it needs a name for the page, for instance, to label a bookmark. The languages it would provide to the algorithm would be the user's preferred languages.

author

The value must be a free-form string giving the name of one of the page's authors.

description

The value must be a free-form string that describes the page. The value must be appropriate for use in a directory of pages, e.g. in a search engine. There must not be more than one [meta](#) element where the [name](#) attribute value is an [ASCII case-insensitive](#) match for [description](#) per document.

generator

The value must be a free-form string that identifies one of the software packages used to generate the document. This value must not be used on pages whose markup is not generated by software, e.g. pages whose markup was written by a user in a text editor.

Here is what a tool called "Frontweaver" could include in its output, in the page's [head](#) element, to identify itself as the tool used to generate the page:

```
<meta name=generator content="Frontweaver 8.2">
```

keywords

The value must be a [set of comma-separated tokens](#), each of which is a keyword relevant to the page.

This page about typefaces on British motorways uses a [meta](#) element to specify some keywords that users might use to look for the page:

```
<!DOCTYPE HTML>
<html lang="en-GB">
  <head>
    <title>Typefaces on UK motorways</title>
    <meta name="keywords" content="british,type face,font,fonts,highway,high
  </head>
  <body>
    ...

```

Many search engines do not consider such keywords, because this feature has historically been used unreliably and even misleadingly as a way to spam search engine results in a way that is not helpful for users.

To obtain the list of keywords that the author has specified as applicable to the page, the user agent must run the following steps:

1. Let *keywords* be an empty list.
2. For each [meta](#) element with a [name](#) attribute and a [content](#) attribute and where the [name](#) attribute value is an [ASCII case-insensitive](#) match for [keywords](#):
 1. [Split the value of the element's content attribute on commas](#).
 2. Add the resulting tokens, if any, to *keywords*.
 3. Remove any duplicates from *keywords*.
4. Return *keywords*. This is the list of keywords that the author has specified as applicable to the page.

User agents should not use this information when there is insufficient confidence in the reliability of the value.

For instance, it would be reasonable for a content management system to use the keyword information of pages within the system to populate the index of a site-specific search engine, but a large-scale content aggregator that used this information would likely find that certain users would try to game its ranking mechanism through the use of inappropriate keywords.

referrer

The value must be a [referrer policy](#), which defines the default [referrer policy](#) for the [Document](#). [\[REFERRERPOLICY\]](#)

If any [meta](#) elements are [inserted into the document](#) or [removed from the document](#), or existing [meta](#) elements have their [name](#) or [content](#) attributes changed, user agents must run the following algorithm:

1. Let *candidate elements* be the list of all [meta](#) elements that meet the following criteria, in [tree order](#):
 - The element is [in a document tree](#)
 - The element has a [name](#) attribute, whose value is an [ASCII case-insensitive match for referrer](#)
 - The element has a [content](#) attribute, whose value is not the empty string
2. For each *element* in *candidate elements*:
 1. Let *value* be the value of *element's* [content](#) attribute, [converted to ASCII lowercase](#).
 2. If *value* is one of the values given in the first column of the following table, then set *value* to the value given in the second column:

Legacy value	Referrer policy
never	no-referrer
default	the default referrer policy
always	unsafe-url
origin-when-crossorigin	origin-when-cross-origin
 3. If *value* is a [referrer policy](#), then set *element's* [node document's](#) [policy container's](#) [referrer policy](#) to *policy*.

The fact that these steps are applied for each element enables [deployment of fallback values for older user agents](#). [\[REFERRERPOLICY\]](#)

theme-color

MDN

[Element/meta/name/theme-color](#)

Firefox No Safari 15+ Chrome 73+

Opera No Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 15+ Chrome Android 80+ WebView Android No Samsung

The value must be a string that matches the CSS [`<color>`](#) production, defining a suggested color that user agents should use to customize the display of the page or of the surrounding user interface. For example, a browser might color the page's title bar with the specified value, or use it as a color highlight in a tab bar or task switcher.

Within an HTML document, the [`**media**`](#) attribute value must be unique amongst all the [`**meta**`](#) elements with their [`**name**`](#) attribute value set to an [`ASCII case-insensitive`](#) match for [`**theme-color**`](#).

This standard itself uses "WHATWG green" as its theme color:

```
<!DOCTYPE HTML>
<title>HTML Standard</title>
<meta name="theme-color" content="#3c790a">
...
...
```

The [`**media**`](#) attribute may be used to describe the context in which the provided color should be used.

If we only wanted to use "WHATWG green" as this standard's theme color in dark mode, we could use the [`prefers-color-scheme`](#) media feature:

```
<!DOCTYPE HTML>
<title>HTML Standard</title>
<meta name="theme-color" content="#3c790a" media="(prefers-color-scheme: d
...
...
```

To obtain a page's theme color, user agents must run the following steps:

1. Let *candidate elements* be the list of all [`**meta**`](#) elements that meet the following criteria, in [`tree order`](#):
 - The element is [`in a document tree`](#)
 - The element has a [`**name**`](#) attribute, whose value is an [`ASCII case-insensitive`](#) match for [`**theme-color**`](#)
 - The element has a [`**content**`](#) attribute
2. For each *element* in *candidate elements*:
 1. If *element* has a [`**media**`](#) attribute and the value of *element*'s [`**media**`](#) attribute does not [`match the environment`](#), then [`continue`](#).
 2. Let *value* be the result of [`stripping leading and trailing ASCII whitespace`](#) from the value of *element*'s [`**content**`](#) attribute.

3. Let *color* be the result of [parsing value](#).
4. If *color* is not failure, then return *color*.
3. Return nothing (the page has no theme color).

If any [**meta**](#) elements are [inserted into the document](#) or [removed from the document](#), or existing [**meta**](#) elements have their [**name**](#), [**content**](#), or [**media**](#) attributes changed, or if the environment changes such that any [**meta**](#) element's [**media**](#) attribute's value may now or may no longer [match the environment](#), user agents must re-run the above algorithm and apply the result to any affected UI.

When using the theme color in UI, user agents may adjust it in implementation-specific ways to make it more suitable for the UI in question. For example, if a user agent intends to use the theme color as a background and display white text over it, it might use a darker variant of the theme color in that part of the UI, to ensure adequate contrast.

color-scheme

To aid user agents in rendering the page background with the desired color scheme immediately (rather than waiting for all CSS in the page to load), a '[color-scheme](#)' value can be provided in a [**meta**](#) element.

The value must be a string that matches the syntax for the CSS '[color-scheme](#)' property value. It determines the [page's supported color-schemes](#).

There must not be more than one [**meta**](#) element with its [**name**](#) attribute value set to an [ASCII case-insensitive](#) match for [**color-scheme**](#) per document.

The following declaration indicates that the page is aware of and can handle a color scheme with dark background colors and light foreground colors:

```
<meta name="color-scheme" content="dark">
```

To obtain a [page's supported color-schemes](#), user agents must run the following steps:

1. Let *candidate elements* be the list of all [**meta**](#) elements that meet the following criteria, in [tree order](#):
 - The element is [in a document tree](#)
 - The element has a [**name**](#) attribute, whose value is an [ASCII case-insensitive](#) match for [**color-scheme**](#)
 - The element has a [**content**](#) attribute
2. For each *element* in *candidate elements*:
 1. Let *parsed* be the result of [parsing a list of component values](#) given the

value of *element's* [content](#) attribute.

2. If *parsed* is a valid CSS '[color-scheme](#)' property value, then return *parsed*.

3. Return null.

If any [meta](#) elements are [inserted into the document](#) or [removed from the document](#), or existing [meta](#) elements have their [name](#) or [content](#) attributes changed, user agents must re-run the above algorithm.

Because these rules check successive elements until they find a match, an author can provide multiple such values to handle fallback for legacy user agents. Opposite to how CSS fallback works for properties, the multiple meta elements needs to be arranged with the legacy values after the newer values.

4.2.5.2 Other metadata names

Anyone can create and use their own *extensions to the predefined set of metadata names*. There is no requirement to register such extensions.

However, a new metadata name should not be created in any of the following cases:

- If either the name is a [URL](#), or the value of its accompanying [content](#) attribute is a [URL](#); in those cases, registering it as an [extension to the predefined set of link types](#) is encouraged (rather than creating a new metadata name).
- If the name is for something expected to have processing requirements in user agents; in that case it ought to be standardized.

Also, before creating and using a new metadata name, consulting the [WHATWG Wiki MetaExtensions page](#) is encouraged — to avoid choosing a metadata name that's already in use, and to avoid duplicating the purpose of any metadata names that are already in use, and to avoid new standardized names clashing with your chosen name. [\[WHATWGWiki\]](#)

Anyone is free to edit the WHATWG Wiki MetaExtensions page at any time to add a metadata name. New metadata names can be specified with the following information:

Keyword

The actual name being defined. The name should not be confusingly similar to any other defined name (e.g. differing only in case).

Brief description

A short non-normative description of what the metadata name's meaning is, including the format the value is required to be in.

Specification

A link to a more detailed description of the metadata name's semantics and requirements.

It could be another page on the wiki, or a link to an external page.

Synonyms

A list of other names that have exactly the same processing requirements. Authors should not use the names defined to be synonyms (they are only intended to allow user agents to support legacy content). Anyone may remove synonyms that are not used in practice; only names that need to be processed as synonyms for compatibility with legacy content are to be registered in this way.

Status

One of the following:

Proposed

The name has not received wide peer review and approval. Someone has proposed it and is, or soon will be, using it.

Ratified

The name has received wide peer review and approval. It has a specification that unambiguously defines how to handle pages that use the name, including when they use it in incorrect ways.

Discontinued

The metadata name has received wide peer review and it has been found wanting. Existing pages are using this metadata name, but new pages should avoid it. The "brief description" and "specification" entries will give details of what authors should use instead, if anything.

If a metadata name is found to be redundant with existing values, it should be removed and listed as a synonym for the existing value.

If a metadata name is added in the "proposed" state for a period of a month or more without being used or specified, then it may be removed from the WHATWG Wiki MetaExtensions page.

If a metadata name is added with the "proposed" status and found to be redundant with existing values, it should be removed and listed as a synonym for the existing value. If a metadata name is added with the "proposed" status and found to be harmful, then it should be changed to "discontinued" status.

Anyone can change the status at any time, but should only do so in accordance with the definitions above.

4.2.5.3 Pragma directives

When the *http-equiv* attribute is specified on a [meta](#) element, the element is a pragma directive.

The [http-equiv](#) attribute is an [enumerated attribute](#). The following table lists the keywords defined for this attribute. The states given in the first cell of the rows with keywords give the states to which those keywords map. Some of the keywords are non-conforming, as noted in the last column.

State	Keyword	Notes
Content Language	<i>content-language</i>	Non-conforming
Encoding declaration	<i>content-type</i>	
Default style	<i>default-style</i>	
Refresh	<i>refresh</i>	
Set-Cookie	<i>set-cookie</i>	Non-conforming
X-UA-Compatible	<i>x-ua-compatible</i>	
Content security policy	<i>content-security-policy</i>	

When a [meta](#) element is [inserted into the document](#), if its [http-equiv](#) attribute is present and represents one of the above states, then the user agent must run the algorithm appropriate for that state, as described in the following list:

Content language state ([http-equiv="content-language"](#))

This feature is non-conforming. Authors are encouraged to use the [lang](#) attribute instead.

This pragma sets the *pragma-set default language*. Until such a pragma is successfully processed, there is no [pragma-set default language](#).

1. If the [meta](#) element has no [content](#) attribute, then return.
2. If the element's [content](#) attribute contains a U+002C COMMA character (,) then return.
3. Let *input* be the value of the element's [content](#) attribute.
4. Let *position* point at the first character of *input*.
5. [Skip ASCII whitespace](#) within *input* given *position*.
6. [Collect a sequence of code points](#) that are not [ASCII whitespace](#) from *input* given *position*.
7. Let *candidate* be the string that resulted from the previous step.
8. If *candidate* is the empty string, return.
9. Set the [pragma-set default language](#) to *candidate*.

If the value consists of multiple space-separated tokens, tokens after the first are

ignored.

This pragma is almost, but not quite, entirely unlike the HTTP '[Content-Language](#)' header of the same name. [\[HTTP\]](#)

Encoding declaration state (`http-equiv="content-type"`)

The [Encoding declaration state](#) is just an alternative form of setting the [charset](#) attribute: it is a [character encoding declaration](#). This state's user agent requirements are all handled by the parsing section of the specification.

For [meta](#) elements with an [http-equiv](#) attribute in the [Encoding declaration state](#), the [content](#) attribute must have a value that is an [ASCII case-insensitive](#) match for a string that consists of: the literal string "text/html;", optionally followed by any number of [ASCII whitespace](#), followed by the literal string "charset=utf-8".

A document must not contain both a [meta](#) element with an [http-equiv](#) attribute in the [Encoding declaration state](#) and a [meta](#) element with the [charset](#) attribute present.

The [Encoding declaration state](#) may be used in [HTML documents](#), but elements with an [http-equiv](#) attribute in that state must not be used in [XML documents](#).

Default style state (`http-equiv="default-style"`)

This pragma sets the [name](#) of the default [CSS style sheet set](#).

1. If the [meta](#) element has no [content](#) attribute, or if that attribute's value is the empty string, then return.
2. [Change the preferred CSS style sheet set name](#) with the name being the value of the element's [content](#) attribute. [\[CSSOM\]](#)

Refresh state (`http-equiv="refresh"`)

This pragma acts as timed redirect.

A [Document](#) object has an associated *will declaratively refresh* (a boolean). It is initially false.

1. If the [meta](#) element has no [content](#) attribute, or if that attribute's value is the empty string, then return.
2. Let *input* be the value of the element's [content](#) attribute.
3. Run the [shared declarative refresh steps](#) with the [meta](#) element's [node document](#), *input*, and the [meta](#) element.

The shared declarative refresh steps, given a [Document](#) object *document*, string *input*, and optionally a [meta](#) element *meta*, are as follows:

1. If *document*'s [will declaratively refresh](#) is true, then return.
2. Let *position* point at the first [code point](#) of *input*.
3. [Skip ASCII whitespace](#) within *input* given *position*.
4. Let *time* be 0.
5. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, and let the result be *timeString*.
6. If *timeString* is the empty string, then:
 1. If the [code point](#) in *input* pointed to by *position* is not U+002E (.), then return.
7. Otherwise, set *time* to the result of parsing *timeString* using the [rules for parsing non-negative integers](#).
8. [Collect a sequence of code points](#) that are [ASCII digits](#) and U+002E FULL STOP characters (.) from *input* given *position*. Ignore any collected characters.
9. Let *urlRecord* be *document*'s [URL](#).
10. If *position* is not past the end of *input*, then:
 1. If the [code point](#) in *input* pointed to by *position* is not U+003B (;), U+002C (,), or [ASCII whitespace](#), then return.
 2. [Skip ASCII whitespace](#) within *input* given *position*.
 3. If the [code point](#) in *input* pointed to by *position* is U+003B (;) or U+002C (,), then advance *position* to the next [code point](#).
 4. [Skip ASCII whitespace](#) within *input* given *position*.
11. If *position* is not past the end of *input*, then:
 1. Let *urlString* be the substring of *input* from the [code point](#) at *position* to the end of the string.
 2. If the [code point](#) in *input* pointed to by *position* is U+0055 (U) or U+0075 (u), then advance *position* to the next [code point](#). Otherwise, jump to the step labeled *skip quotes*.

3. If the [code point](#) in *input* pointed to by *position* is U+0052 (R) or U+0072 (r), then advance *position* to the next [code point](#). Otherwise, jump to the step labeled *parse*.
 4. If the [code point](#) in *input* pointed to by *position* is U+004C (L) or U+006C (l), then advance *position* to the next [code point](#). Otherwise, jump to the step labeled *parse*.
 5. [Skip ASCII whitespace](#) within *input* given *position*.
 6. If the [code point](#) in *input* pointed to by *position* is U+003D (=), then advance *position* to the next [code point](#). Otherwise, jump to the step labeled *parse*.
 7. [Skip ASCII whitespace](#) within *input* given *position*.
 8. *Skip quotes*: If the [code point](#) in *input* pointed to by *position* is U+0027 ('') or U+0022 (""), then let *quote* be that [code point](#), and advance *position* to the next [code point](#). Otherwise, let *quote* be the empty string.
 9. Set *urlString* to the substring of *input* from the [code point](#) at *position* to the end of the string.
 10. If *quote* is not the empty string, and there is a [code point](#) in *urlString* equal to *quote*, then truncate *urlString* at that [code point](#), so that it and all subsequent [code points](#) are removed.
 11. *Parse*: [Parse](#) *urlString* relative to *document*. If that fails, return. Otherwise, set *urlRecord* to the [resulting URL record](#).
 12. Set *document*'s [will declaratively refresh](#) to true.
 13. Perform one or more of the following steps:
 - After the refresh has come due (as defined below), if the user has not canceled the redirect and, if *meta* is given, *document*'s [active sandboxing flag set](#) does not have the [sandboxed automatic features browsing context flag](#) set, then [navigate](#) *document*'s [browsing context](#) to *urlRecord*, with [historyHandling](#) set to "[replace](#)" and the [source browsing context](#) set to *document*'s [browsing context](#).
- For the purposes of the previous paragraph, a refresh is said to have come due as soon as the *later* of the following two conditions occurs:
- At least *time* seconds have elapsed since *document*'s [completely loaded time](#), adjusted to take into account user or user agent preferences.
 - If *meta* is given, at least *time* seconds have elapsed since *meta* was

[inserted into the document](#) *document*, adjusted to take into account user or user agent preferences.

It is important to use *document* here, and not *meta*'s [node document](#), as that might have changed between the initial set of steps and the refresh coming due and *meta* is not always given (in case of the HTTP '[Refresh](#)' header).

- Provide the user with an interface that, when selected, [navigates](#) a [browsing context](#) to *urlRecord*, with *document*'s [browsing context](#) as the [source browsing context](#).
- Do nothing.

In addition, the user agent may, as with anything, inform the user of any and all aspects of its operation, including the state of any timers, the destinations of any timed redirects, and so forth.

For [meta](#) elements with an [http-equiv](#) attribute in the [Refresh state](#), the [content](#) attribute must have a value consisting either of:

- just a [valid non-negative integer](#), or
- a [valid non-negative integer](#), followed by a U+003B SEMICOLON character (;), followed by one or more [ASCII whitespace](#), followed by a substring that is an [ASCII case-insensitive](#) match for the string "[URL](#)", followed by a U+003D EQUALS SIGN character (=), followed by a [valid URL string](#) that does not start with a literal U+0027 APOSTROPHE ('') or U+0022 QUOTATION MARK ("") character.

In the former case, the integer represents a number of seconds before the page is to be reloaded; in the latter case the integer represents a number of seconds before the page is to be replaced by the page at the given [URL](#).

A news organization's front page could include the following markup in the page's [head](#) element, to ensure that the page automatically reloads from the server every five minutes:

```
<meta http-equiv="Refresh" content="300">
```

A sequence of pages could be used as an automated slide show by making each page refresh to the next page in the sequence, using markup such as the following:

```
<meta http-equiv="Refresh" content="20; URL=page4.html">
```

Set-Cookie state ([http-equiv="set-cookie"](#))

This pragma is non-conforming and has no effect.

User agents are required to ignore this pragma.

X-UA-Compatible state ([http-equiv="x-ua-compatible"](#))

In practice, this pragma encourages Internet Explorer to more closely follow the specifications.

For [meta](#) elements with an [http-equiv](#) attribute in the [X-UA-Compatible state](#), the [content](#) attribute must have a value that is an [ASCII case-insensitive](#) match for the string "IE=edge".

User agents are required to ignore this pragma.

Content security policy state ([http-equiv="content-security-policy"](#))

This pragma [enforces](#) a [Content Security Policy](#) on a [Document](#). [\[CSP\]](#)

1. If the [meta](#) element is not a child of a [head](#) element, return.
2. If the [meta](#) element has no [content](#) attribute, or if that attribute's value is the empty string, then return.
3. Let *policy* be the result of executing Content Security Policy's [parse a serialized Content Security Policy](#) algorithm on the [meta](#) element's [content](#) attribute's value, with a source of "meta", and a disposition of "enforce".
4. Remove all occurrences of the [report-uri](#), [frame-ancestors](#), and [sandbox directives](#) from *policy*.
5. [Enforce the policy](#) *policy*.

For [meta](#) elements with an [http-equiv](#) attribute in the [Content security policy state](#), the [content](#) attribute must have a value consisting of a [valid Content Security Policy](#), but must not contain any [report-uri](#), [frame-ancestors](#), or [sandbox directives](#). The [Content Security Policy](#) given in the [content](#) attribute will be [enforced](#) upon the current document. [\[CSP\]](#)

A page might choose to mitigate the risk of cross-site scripting attacks by preventing the execution of inline JavaScript, as well as blocking all plugin content, using a policy such as the following:

```
<meta http-equiv="Content-Security-Policy" content="script-src 'self'; obj
```

There must not be more than one [meta](#) element with any particular state in the document at a time.

4.2.5.4 Specifying the document's character encoding

A *character encoding declaration* is a mechanism by which the [character encoding](#) used to store

or transmit a document is specified.

The Encoding standard requires use of the [UTF-8 character encoding](#) and requires use of the "[utf-8](#)" [encoding label](#) to identify it. Those requirements necessitate that the document's [character encoding declaration](#), if it exists, specifies an [encoding label](#) using an [ASCII case-insensitive](#) match for "[utf-8](#)". Regardless of whether a [character encoding declaration](#) is present or not, the actual [character encoding](#) used to encode the document must be [UTF-8](#). [\[ENCODING\]](#)

To enforce the above rules, authoring tools must default to using [UTF-8](#) for newly-created documents.

The following restrictions also apply:

- The character encoding declaration must be serialized without the use of [character references](#) or character escapes of any kind.
- The element containing the character encoding declaration must be serialized completely within the first 1024 bytes of the document.

In addition, due to a number of restrictions on [meta](#) elements, there can only be one [meta](#)-based character encoding declaration per document.

If an [HTML document](#) does not start with a BOM, and its [encoding](#) is not explicitly given by [Content-Type metadata](#), and the document is not [an iframe srcdoc document](#), then the encoding must be specified using a [meta](#) element with a [charset](#) attribute or a [meta](#) element with an [http-equiv](#) attribute in the [Encoding declaration state](#).

A character encoding declaration is required (either in the [Content-Type metadata](#) or explicitly in the file) even when all characters are in the ASCII range, because a character encoding is needed to process non-ASCII characters entered by the user in forms, in URLs generated by scripts, and so forth.

Using non-UTF-8 encodings can have unexpected results on form submission and URL encodings, which use the [document's character encoding](#) by default.

If the document is [an iframe srcdoc document](#), the document must not have a [character encoding declaration](#). (In this case, the source is already decoded, since it is part of the document that contained the [iframe](#).)

In XML, the XML declaration should be used for inline character encoding information, if necessary.

In HTML, to declare that the character encoding is [UTF-8](#), the author could include the following markup near the top of the document (in the [head](#) element):

```
<meta charset="utf-8">
```

In XML, the XML declaration would be used instead, at the very top of the markup:

```
<?xml version="1.0" encoding="utf-8"?>
```

4.2.6 The **style** element

✓MDN

Element/style

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 3.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 3+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

✓MDN

HTMLStyleElement

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

Metadata content.

Contexts in which this element can be used:

Where metadata content is expected.

In a noscript element that is a child of a head element.

Content model:

Text that gives a conformant style sheet.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

media — Applicable media

Also, the [title](#) attribute has special semantics on this element: [CSS style sheet set name](#).

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLStyleElement : HTMLElement {
  [HTMLConstructor] constructor();
  [CEReactions] attribute DOMString media;
  // also has obsolete members
};
HTMLStyleElement includes LinkStyle;
```

The [style](#) element allows authors to embed CSS style sheets in their documents. The [style](#) element is one of several inputs to the styling processing model. The element does not [represent](#) content for the user.

The [media](#) attribute says which media the styles apply to. The value must be a [valid media query list](#). The user agent must apply the styles when the [media](#) attribute's value [matches the environment](#) and the other relevant conditions apply, and must not apply them otherwise.

The styles might be further limited in scope, e.g. in CSS with the use of @media blocks. This specification does not override such further restrictions or requirements.

The default, if the [media](#) attribute is omitted, is "all", meaning that by default styles apply to all media.

The [title](#) attribute on [style](#) elements defines [CSS style sheet sets](#). If the [style](#) element has no [title](#) attribute, then it has no title; the [title](#) attribute of ancestors does not apply to the [style](#) element. If the [style](#) element is not [in a document tree](#), then the [title](#) attribute is ignored. [\[CSSOM\]](#)

The [title](#) attribute on [style](#) elements, like the [title](#) attribute on [link](#) elements, differs from the global [title](#) attribute in that a [style](#) block without a title does not inherit the title of the parent element: it merely has no title.

The [child text content](#) of a [style](#) element must be that of a [conformant style sheet](#).

The user agent must run the [update a style block](#) algorithm whenever one of the following conditions occur:

- The element is popped off the [stack of open elements](#) of an [HTML parser](#) or [XML parser](#).
- The element is not on the [stack of open elements](#) of an [HTML parser](#) or [XML parser](#), and it [becomes connected](#) or [disconnected](#).
- The element's [children changed steps](#) run.

The *update a style block* algorithm is as follows:

1. Let *element* be the [style](#) element.
2. If *element* has an [associated CSS style sheet](#), [remove the CSS style sheet](#) in question.
3. If *element* is not [connected](#), then return.
4. If *element*'s [type](#) attribute is present and its value is neither the empty string nor an [ASCII case-insensitive](#) match for "[text/css](#)", then return.

In particular, a [type](#) value with parameters, such as "[text/css; charset=utf-8](#)", will cause this algorithm to return early.

5. If the [Should element's inline behavior be blocked by Content Security Policy?](#) algorithm returns "Blocked" when executed upon the [style](#) element, "[style](#)", and the [style](#) element's [child text content](#), then return. [\[CSP\]](#)
6. [Create a CSS style sheet](#) with the following properties:

[type](#)

[text/css](#)

[owner node](#)

element

[media](#)

The [media](#) attribute of *element*.

This is a reference to the (possibly absent at this time) attribute, rather than a copy of the attribute's current value. *CSSOM* defines what happens when the attribute is dynamically set, changed, or removed.

[title](#)

The [title](#) attribute of *element*, if *element* is [in a document tree](#), or the empty string otherwise.

Again, this is a *reference* to the attribute.

[alternate flag](#)

Unset.

[origin-clean flag](#)

Set.

[location](#)

[parent CSS style sheet](#)

[owner CSS rule](#)

null

[disabled flag](#)

Left at its default value.

[CSS rules](#)

Left uninitialized.

This doesn't seem right. Presumably we should be using the element's [child text content](#)? Tracked as [issue #2997](#).

Once the attempts to obtain the style sheet's [critical subresources](#), if any, are complete, or, if the style sheet has no [critical subresources](#), once the style sheet has been parsed and processed, the user agent must run these steps:

1. Let *element* be the [style](#) element associated with the style sheet in question.
2. Let *success* be true.
3. If the attempts to obtain any of the style sheet's [critical subresources](#) failed for any reason (e.g., DNS error, HTTP 404 response, a connection being prematurely closed, unsupported Content-Type), set *success* to false.

Note that content-specific errors, e.g., CSS parse errors or PNG decoding errors, do not affect *success*.

4. [Queue an element task](#) on the [networking task source](#) given *element* and the following steps:
 1. If *success* is true, [fire an event](#) named [load](#) at *element*.
 2. Otherwise, [fire an event](#) named [error](#) at *element*.

3. If *element* contributes a script-blocking style sheet:

1. Assert: *element*'s [node document](#)'s [script-blocking style sheet counter](#) is greater than 0.
2. Decrement *element*'s [node document](#)'s [script-blocking style sheet counter](#) by 1.

The element must [delay the load event](#) of the element's [node document](#) until all the attempts to obtain the style sheet's [critical subresources](#), if any, are complete.

This specification does not specify a style system, but CSS is expected to be supported by most web browsers. [\[CSS\]](#)



[HTMLStyleElement/media](#)

Support in all current engines.

Firefox 1+ | Safari 3+ | Chrome 1+

Opera 12.1+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 5.5+

Firefox | Android 4+ | Safari iOS 1+ | Chrome | Android 18+ | WebView | Android 1+ | Samsung Internet 1.0+ | Opera | Android 12.1+

The **media** IDL attribute must [reflect](#) the content attribute of the same name.

The [LinkStyle](#) interface is also implemented by this element. [\[CSSOM\]](#)

The following document has its stress emphasis styled as bright red text rather than italics text, while leaving titles of works and Latin words in their default italics. It shows how using appropriate elements enables easier restyling of documents.

```
<!DOCTYPE html>
<html lang="en-US">
  <head>
    <title>My favorite book</title>
    <style>
      body { color: black; background: white; }
      em { font-style: normal; color: red; }
    </style>
  </head>
  <body>
    <p>My <em>favorite</em> book of all time has <em>got</em> to be
      <cite>A Cat's Life</cite>. It is a book by P. Rahmel that talks
      about the <i lang="la">Felis catus</i> in modern human society.</p>
```

```
</body>
</html>
```

4.2.7 Interactions of styling and scripting

If the style sheet referenced no other resources (e.g., it was an internal style sheet given by a [style](#) element with no [@import](#) rules), then the style rules must be [immediately](#) made available to script; otherwise, the style rules must only be made available to script once the [event loop](#) reaches its [update the rendering](#) step.

An element *el* in the context of a [Document](#) of an [HTML parser](#) or [XML parser](#) *contributes a script-blocking style sheet* if all of the following conditions are true:

- *el* was created by that [Document](#)'s parser.
- *el* is either a [style](#) element or a [link](#) element that was an [external resource link that contributes to the styling processing model](#) when the *el* was created by the parser.
- If the *el* is a [link](#) element, its [media](#) attribute's value [matches the environment](#).
- *el*'s style sheet was enabled when the element was created by the parser.
- The last time the [event loop](#) reached [step 1](#), *el*'s [root](#) was that [Document](#).
- The user agent hasn't given up on loading that particular style sheet yet. A user agent may give up on loading a style sheet at any time.

Giving up on a style sheet before the style sheet loads, if the style sheet eventually does still load, means that the script might end up operating with incorrect information. For example, if a style sheet sets the color of an element to green, but a script that inspects the resulting style is executed before the sheet is loaded, the script will find that the element is black (or whatever the default color is), and might thus make poor choices (e.g., deciding to use black as the color elsewhere on the page, instead of green).

Implementers have to balance the likelihood of a script using incorrect information with the performance impact of doing nothing while waiting for a slow network request to finish.

It is expected that counterparts to the above rules also apply to [<?xml-stylesheet?>](#) PIs and HTTP '[Link](#)' headers. However, this has not yet been thoroughly investigated.

A [Document](#) has a *script-blocking style sheet counter*, which is a number, initially 0.

A [Document](#) has a *style sheet that is blocking scripts* if its [script-blocking style sheet counter](#) is greater than 0, or if that [Document](#) has a non-null [browsing context](#) whose [container document](#) is non-null and has a [script-blocking style sheet counter](#) greater than 0.

A [Document](#) has *no style sheet that is blocking scripts* if it does not [have a style sheet that is](#)

[blocking scripts](#) as defined in the previous paragraph.

4.3 Sections



[Introduction_to_HTML/Document_and_website_structure#HTML_for_structuring_content](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 4.2+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11.1+

4.3.1 The **body** element



[Element/body](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android 18+ WebView Android Yes Samsung Internet 1.0+ Opera Android Yes



[HTMLBodyElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

[Sectioning root](#).

Contexts in which this element can be used:

As the second element in an [html](#) element.

[Content model:](#)

[Flow content.](#)

[Tag omission in text/html:](#)

A **body** element's [start tag](#) can be omitted if the element is empty, or if the first thing inside the **body** element is not [ASCII whitespace](#) or a [comment](#), except if the first thing inside the **body** element is a [meta](#), [link](#), [script](#), [style](#), or [template](#) element.

A **body** element's [end tag](#) can be omitted if the **body** element is not immediately followed by a [comment](#).

[Content attributes:](#)

[Global attributes](#)

[onafterprint](#)

[onbeforeprint](#)

[onbeforeunload](#)

[onhashchange](#)

[onlanguagechange](#)

[onmessage](#)

[onmessageerror](#)

[onoffline](#)

[ononline](#)

[onpagehide](#)

[onpageshow](#)

[onpopstate](#)

[onrejectionhandled](#)

[onstorage](#)

[onunhandledrejection](#)

[onunload](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLBodyElement : HTMLElement {
    [HTMLConstructor] constructor();

    // also has obsolete members
};

HTMLBodyElement includes WindowEventHandlers;
```

The [body](#) element [represents](#) the contents of the document.

In conforming documents, there is only one [body](#) element. The [document.body](#) IDL attribute provides scripts with easy access to a document's [body](#) element.

Some DOM operations (for example, parts of the [drag and drop](#) model) are defined in terms of "[the body element](#)". This refers to a particular element in the DOM, as per the definition of the term, and not any arbitrary [body](#) element.

The [body](#) element exposes as [event handler content attributes](#) a number of the [event handlers](#) of the [Window](#) object. It also mirrors their [event handler IDL attributes](#).

The [event handlers](#) of the [Window](#) object named by the [Window-reflecting body element event handler set](#), exposed on the [body](#) element, replace the generic [event handlers](#) with the same names normally supported by [HTML elements](#).

Thus, for example, a bubbling [error](#) event dispatched on a child of [the body element](#) of a [Document](#) would first trigger the [onerror event handler content attributes](#) of that element, then that of the root [html](#) element, and only *then* would it trigger the [onerror event handler content attribute](#) on the [body](#) element. This is because the event would bubble from the target, to the [body](#), to the [html](#), to the [Document](#), to the [Window](#), and the [event handler](#) on the [body](#) is watching the [Window](#) not the [body](#). A regular event listener attached to the [body](#) using [addEventListener\(\)](#), however, would be run when the event bubbled through the [body](#) and not when it reaches the [Window](#) object.

This page updates an indicator to show whether or not the user is online:

```
<!DOCTYPE HTML>
<html lang="en">
<head>
    <title>Online or offline?</title>
    <script>
        function update(online) {
            document.getElementById('status').textContent =
                online ? 'Online' : 'Offline';
    }</script>
```

```
</script>
</head>
<body ononline="update(true)"
      onoffline="update(false)"
      onload="update(navigator.onLine)">
  <p>You are: <span id="status">(Unknown)</span></p>
</body>
</html>
```

4.3.2 The **article** element



[Element/article](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 4.2+ Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android 11.1+

Categories:

[Flow content](#).

[Sectioning content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [sectioning content](#) is expected.

[Content model:](#)

[Flow content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

Uses [HTMLElement](#).

The [article](#) element [represents](#) a complete, or self-contained, composition in a document, page, application, or site and that is, in principle, independently distributable or reusable, e.g. in syndication. This could be a forum post, a magazine or newspaper article, a blog entry, a user-submitted comment, an interactive widget or gadget, or any other independent item of content.

When [article](#) elements are nested, the inner [article](#) elements represent articles that are in principle related to the contents of the outer article. For instance, a blog entry on a site that accepts user-submitted comments could represent the comments as [article](#) elements nested within the [article](#) element for the blog entry.

Author information associated with an [article](#) element (q.v. the [address](#) element) does not apply to nested [article](#) elements.

When used specifically with content to be redistributed in syndication, the [article](#) element is similar in purpose to the [entry](#) element in Atom. [\[ATOM\]](#)

The schema.org microdata vocabulary can be used to provide the publication date for an [article](#) element, using one of the CreativeWork subtypes.

When the main content of the page (i.e. excluding footers, headers, navigation blocks, and sidebars) is all one single self-contained composition, that content may be marked with an [article](#), but it is technically redundant in that case (since it's self-evident that the page is a single composition, as it is a single document).

This example shows a blog post using the [article](#) element, with some schema.org annotations:

```
<article itemscope itemtype="http://schema.org/BlogPosting">
  <header>
    <h1 itemprop="headline">The Very First Rule of Life</h1>
    <p><time itemprop="datePublished" datetime="2009-10-09">3 days ago</time></p>
    <link itemprop="url" href="?comments=0">
  </header>
  <p>If there's a microphone anywhere near you, assume it's hot and
  sending whatever you're saying to the world. Seriously.</p>
  <p>...</p>
  <footer>
    <a itemprop="discussionUrl" href="?comments=1">Show comments...</a>
  </footer>
</article>
```

Here is that same blog post, but showing some of the comments:

```
<article itemscope itemtype="http://schema.org/BlogPosting">
  <header>
    <h1 itemprop="headline">The Very First Rule of Life</h1>
    <p><time itemprop="datePublished" datetime="2009-10-09">3 days ago</time></p>
    <div>
      <comment>
        <content>This is a comment!</content>
        <author>John Doe</author>
        <date>2009-10-09</date>
      </comment>
      <comment>
        <content>Great post!</content>
        <author>Jane Smith</author>
        <date>2009-10-09</date>
      </comment>
    </div>
  </header>
  <div>
    <comment>
      <content>This is a comment!</content>
      <author>John Doe</author>
      <date>2009-10-09</date>
    </comment>
    <comment>
      <content>Great post!</content>
      <author>Jane Smith</author>
      <date>2009-10-09</date>
    </comment>
  </div>
</article>
```

```

<link itemprop="url" href="?comments=0">
</header>
<p>If there's a microphone anywhere near you, assume it's hot and
sending whatever you're saying to the world. Seriously.</p>
<p>...</p>
<section>
  <h1>Comments</h1>
  <article itemprop="comment" itemscope itemtype="http://schema.org/UserComment">
    <link itemprop="url" href="#c1">
    <footer>
      <p>Posted by: <span itemprop="creator" itemscope itemtype="http://schema.org/Person">
        <span itemprop="name">George Washington</span>
      </span></p>
      <p><time itemprop="commentTime" datetime="2009-10-10">15 minutes ago</time>
    </footer>
    <p>Yeah! Especially when talking about your lobbyist friends!</p>
  </article>
  <article itemprop="comment" itemscope itemtype="http://schema.org/UserComment">
    <link itemprop="url" href="#c2">
    <footer>
      <p>Posted by: <span itemprop="creator" itemscope itemtype="http://schema.org/Person">
        <span itemprop="name">George Hammond</span>
      </span></p>
      <p><time itemprop="commentTime" datetime="2009-10-10">5 minutes ago</time>
    </footer>
    <p>Hey, you have the same first name as me.</p>
  </article>
</section>
</article>
```

Notice the use of **footer** to give the information for each comment (such as who wrote it and when): the **footer** element *can* appear at the start of its section when appropriate, such as in this case. (Using **header** in this case wouldn't be wrong either; it's mostly a matter of authoring preference.)

In this example, **article** elements are used to host widgets on a portal page. The widgets are implemented as **customized built-in elements** in order to get specific styling and scripted behavior.

```
<!DOCTYPE HTML>
<html lang=en>
<title>eHome Portal</title>
<script src="/scripts/widgets.js"></script>
<link rel=stylesheet href="/styles/main.css">
<article is="stock-widget">
  <h1>Stocks</h1>
  <table>
```

```

<thead> <tr> <th> Stock <th> Value <th> Delta
<tbody> <template> <tr> <td> <td> <td> </template>
</table>
<p> <input type=button value="Refresh" onclick="this.parentElement.refresh()"
</article>
<article is="news-widget">
  <h1>News</h1>
  <ul>
    <template>
      <li>
        <p><img> <strong></strong>
        <p>
      </template>
    </ul>
    <p> <input type=button value="Refresh" onclick="this.parentElement.refresh()"
</article>

```

4.3.3 The **section** element



[Element/section](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 4.2+ Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android 11.1+

[Categories:](#)

[Flow content.](#)

[Sectioning content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [sectioning content](#) is expected.

[Content model:](#)

[Flow content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [section](#) element [represents](#) a generic section of a document or application. A section, in this context, is a thematic grouping of content, typically with a heading.

Examples of sections would be chapters, the various tabbed pages in a tabbed dialog box, or the numbered sections of a thesis. A web site's home page could be split into sections for an introduction, news items, and contact information.

Authors are encouraged to use the [article](#) element instead of the [section](#) element when it would make sense to syndicate the contents of the element.

The [section](#) element is not a generic container element. When an element is needed only for styling purposes or as a convenience for scripting, authors are encouraged to use the [div](#) element instead. A general rule is that the [section](#) element is appropriate only if the element's contents would be listed explicitly in the document's [outline](#).

In the following example, we see an article (part of a larger web page) about apples, containing two short sections.

```
<article>
  <hgroup>
    <h1>Apples</h1>
    <h2>Tasty, delicious fruit!</h2>
  </hgroup>
  <p>The apple is the pomaceous fruit of the apple tree.</p>
  <section>
    <h1>Red Delicious</h1>
    <p>These bright red apples are the most common found in many
       supermarkets.</p>
  </section>
  <section>
    <h1>Granny Smith</h1>
    <p>These juicy, green apples make a great filling for
       apple pies.</p>
  </section>
</article>
```

Notice how the use of [section](#) means that the author can use [h1](#) elements throughout,

without having to worry about whether a particular section is at the top level, the second level, the third level, and so on.

Here is a graduation programme with two sections, one for the list of people graduating, and one for the description of the ceremony. (The markup in this example features an uncommon style sometimes used to minimize the amount of [inter-element whitespace](#).)

```
<!DOCTYPE Html>
<Html Lang=En
  ><Head
    ><Title
      >Graduation Ceremony Summer 2022</Title
    ></Head
  ><Body
    ><H1
      >Graduation</H1
    ><Section
      ><H1
        >Ceremony</H1
      ><P
        >Opening Procession</P
      ><P
        >Speech by Valedictorian</P
      ><P
        >Speech by Class President</P
      ><P
        >Presentation of Diplomas</P
      ><P
        >Closing Speech by Headmaster</P
    ></Section
    ><Section
      ><H1
        >Graduates</H1
      ><Ul
        ><Li
          >Molly Carpenter</Li
        ><Li
          >Anastasia Luccio</Li
        ><Li
          >Ebenezar McCoy</Li
        ><Li
          >Karrin Murphy</Li
        ><Li
          >Thomas Raith</Li
        ><Li
          >Susan Rodriguez</Li
      ></Ul
```

```
></Section>
></Body>
></Html>
```

In this example, a book author has marked up some sections as chapters and some as appendices, and uses CSS to style the headers in these two classes of section differently.

```
<style>
  section { border: double medium; margin: 2em; }
  section.chapter h1 { font: 2em Roboto, Helvetica Neue, sans-serif; }
  section.appendix h1 { font: small-caps 2em Roboto, Helvetica Neue, sans-serif; }
</style>
<header>
  <hgroup>
    <h1>My Book</h1>
    <h2>A sample with not much content</h2>
  </hgroup>
  <p><small>Published by Dummy Publicorp Ltd.</small></p>
</header>
<section class="chapter">
  <h1>My First Chapter</h1>
  <p>This is the first of my chapters. It doesn't say much.</p>
  <p>But it has two paragraphs!</p>
</section>
<section class="chapter">
  <h1>It Continues: The Second Chapter</h1>
  <p>Bla dee bla, dee bla dee bla. Boom.</p>
</section>
<section class="chapter">
  <h1>Chapter Three: A Further Example</h1>
  <p>It's not like a battle between brightness and earthtones would go unnoticed.</p>
  <p>But it might ruin my story.</p>
</section>
<section class="appendix">
  <h1>Appendix A: Overview of Examples</h1>
  <p>These are demonstrations.</p>
</section>
<section class="appendix">
  <h1>Appendix B: Some Closing Remarks</h1>
  <p>Hopefully this long example shows that you <em>can</em> style sections, so long as they are used to indicate actual sections.</p>
</section>
```

4.3.4 The ***nav*** element

✓MDN

[Element/nav](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 4.2+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11.1+

[Categories:](#)

[Flow content.](#)

[Sectioning content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [sectioning content](#) is expected.

[Content model:](#)

[Flow content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The ***nav*** element [represents](#) a section of a page that links to other pages or to parts within the page: a section with navigation links.

Not all groups of links on a page need to be in a ***nav*** element — the element is primarily intended for sections that consist of major navigation blocks. In particular, it is common for footers to have a short list of links to various pages of a site, such as the terms of service, the home page, and a copyright page. The [footer](#) element alone is sufficient for such cases; while a ***nav*** element can be used in such cases, it is usually unnecessary.

User agents (such as screen readers) that are targeted at users who can benefit from navigation information being omitted in the initial rendering, or who can benefit from navigation information being immediately available, can use this element as a way to determine what content on the page to initially skip or provide on request (or both).

In the following example, there are two `nav` elements, one for primary navigation around the site, and one for secondary navigation around the page itself.

```
<body>
  <h1>The Wiki Center Of Exampland</h1>
  <nav>
    <ul>
      <li><a href="/">Home</a></li>
      <li><a href="/events">Current Events</a></li>
      ...more...
    </ul>
  </nav>
  <article>
    <header>
      <h1>Demos in Exampland</h1>
      <p>Written by A. N. Other.</p>
    </header>
    <nav>
      <ul>
        <li><a href="#public">Public demonstrations</a></li>
        <li><a href="#destroy">Demolitions</a></li>
        ...more...
      </ul>
    </nav>
    <div>
      <section id="public">
        <h1>Public demonstrations</h1>
        <p>...more...</p>
      </section>
      <section id="destroy">
        <h1>Demolitions</h1>
        <p>...more...</p>
      </section>
      ...more...
    </div>
    <footer>
      <p><a href="?edit">Edit</a> | <a href="?delete">Delete</a> | <a href="?Ren...
    </footer>
  </article>
  <footer>
    <p><small>© copyright 1998 Exampland Emperor</small></p>
  </footer>
```

```
</body>
```

In the following example, the page has several places where links are present, but only one of those places is considered a navigation section.

```
<body itemscope itemtype="http://schema.org/Blog">
  <header>
    <h1>Wake up sheeple!</h1>
    <p><a href="news.html">News</a> -
      <a href="blog.html">Blog</a> -
      <a href="forums.html">Forums</a></p>
    <p>Last Modified: <span itemprop="dateModified">2009-04-01</span></p>
    <nav>
      <h1>Navigation</h1>
      <ul>
        <li><a href="articles.html">Index of all articles</a></li>
        <li><a href="today.html">Things sheeple need to wake up for today</a></li>
        <li><a href="successes.html">Sheeple we have managed to wake</a></li>
      </ul>
    </nav>
  </header>
  <main>
    <article itemprop="blogPosts" itemscope itemtype="http://schema.org/BlogPost">
      <header>
        <h1 itemprop="headline">My Day at the Beach</h1>
      </header>
      <div itemprop="articleBody">
        <p>Today I went to the beach and had a lot of fun.</p>
        ...more content...
      </div>
      <footer>
        <p>Posted <time itemprop="datePublished" datetime="2009-10-10">Thursday</time>
      </footer>
    </article>
    ...more blog posts...
  </main>
  <footer>
    <p>Copyright ©
      <span itemprop="copyrightYear">2010</span>
      <span itemprop="copyrightHolder">The Example Company</span>
    </p>
    <p><a href="about.html">About</a> -
      <a href="policy.html">Privacy Policy</a> -
      <a href="contact.html">Contact Us</a></p>
  </footer>
</body>
```

You can also see microdata annotations in the above example that use the schema.org vocabulary to provide the publication date and other metadata about the blog post.

A [nav](#) element doesn't have to contain a list, it can contain other kinds of content as well. In this navigation block, links are provided in prose:

```
<nav>
  <h1>Navigation</h1>
  <p>You are on my home page. To the north lies <a href="/blog">my blog</a>, from whence the sounds of battle can be heard. To the east you can see a large mountain, upon which many <a href="/school">school papers</a> are littered. Far up thus mountain you can spy a little figure who appears to be me, desperately scribbling a <a href="/school/thesis">thesis</a>. </p>
  <p>To the west are several exits. One fun-looking exit is labeled <a href="https://games.example.com/">games</a>. Another more boring-looking exit is labeled <a href="https://isp.example.net/">ISP™</a>. </p>
  <p>To the south lies a dark and dank <a href="/about">contacts page</a>. Cobwebs cover its disused entrance, and at one point you see a rat run quickly out of the page.</p>
</nav>
```

In this example, [nav](#) is used in an email application, to let the user switch folders:

```
<p><input type=button value="Compose" onclick="compose()"></p>
<nav>
  <h1>Folders</h1>
  <ul>
    <li> <a href="/inbox" onclick="return openFolder(this.href)">Inbox</a> <span>
    <li> <a href="/sent" onclick="return openFolder(this.href)">Sent</a>
    <li> <a href="/drafts" onclick="return openFolder(this.href)">Drafts</a>
    <li> <a href="/trash" onclick="return openFolder(this.href)">Trash</a>
    <li> <a href="/customers" onclick="return openFolder(this.href)">Customers</a>
  </ul>
</nav>
```

4.3.5 The **aside** element



[Element/aside](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.1+ Edge 79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS4.2+Chrome AndroidYesWebView AndroidYesSamsung InternetYesOpera Android11.1+

Categories:

[Flow content](#).

[Sectioning content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [sectioning content](#) is expected.

Content model:

[Flow content](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

Uses [HTMLElement](#).

The **aside** element [represents](#) a section of a page that consists of content that is tangentially related to the content around the **aside** element, and which could be considered separate from that content. Such sections are often represented as sidebars in printed typography.

The element can be used for typographical effects like pull quotes or sidebars, for advertising, for groups of **nav** elements, and for other content that is considered separate from the main content of the page.

It's not appropriate to use the **aside** element just for parentheticals, since those are part of the main flow of the document.

The following example shows how an aside is used to mark up background material on Switzerland in a much longer news story on Europe.

```
<aside>
  <h1>Switzerland</h1>
  <p>Switzerland, a land-locked country in the middle of geographic Europe, has not joined the geopolitical European Union, though it is
```

```
a signatory to a number of European treaties.</p>
</aside>
```

The following example shows how an aside is used to mark up a pull quote in a longer article.

...

```
<p>He later joined a large company, continuing on the same work.
<q>I love my job. People ask me what I do for fun when I'm not at
work. But I'm paid to do my hobby, so I never know what to
answer. Some people wonder what they would do if they didn't have to
work... but I know what I would do, because I was unemployed for a
year, and I filled that time doing exactly what I do now.</q></p>
```

```
<aside>
```

```
  <q> People ask me what I do for fun when I'm not at work. But I'm
    paid to do my hobby, so I never know what to answer. </q>
</aside>
```

```
<p>Of course his work – or should that be hobby? –
isn't his only passion. He also enjoys other pleasures.</p>
```

...

The following extract shows how [aside](#) can be used for blogrolls and other side content on a blog:

```
<body>
  <header>
    <h1>My wonderful blog</h1>
    <p>My tagline</p>
  </header>
  <aside>
    <!-- this aside contains two sections that are tangentially related
    to the page, namely, links to other blogs, and links to blog posts
    from this blog -->
    <nav>
      <h2>My blogroll</h2>
      <ul>
        <li><a href="https://blog.example.com/">Example Blog</a>
      </ul>
    </nav>
    <nav>
      <h2>Archives</h2>
      <ol reversed>
        <li><a href="/last-post">My last post</a>
        <li><a href="/first-post">My first post</a>
      </ol>
    </nav>
  </aside>
```

```
</ol>
</nav>
</aside>
<aside>
  <!-- this aside is tangentially related to the page also, it
  contains twitter messages from the blog author -->
  <h1>Twitter Feed</h1>
  <blockquote cite="https://twitter.example.net/t31351234">
    I'm on vacation, writing my blog.
  </blockquote>
  <blockquote cite="https://twitter.example.net/t31219752">
    I'm going to go on vacation soon.
  </blockquote>
</aside>
<article>
  <!-- this is a blog post -->
  <h1>My last post</h1>
  <p>This is my last post.</p>
  <footer>
    <p><a href="/last-post" rel=bookmark>Permalink</a>
  </footer>
</article>
<article>
  <!-- this is also a blog post -->
  <h1>My first post</h1>
  <p>This is my first post.</p>
  <aside>
    <!-- this aside is about the blog post, since it's inside the
    <article> element; it would be wrong, for instance, to put the
    blogroll here, since the blogroll isn't really related to this post
    specifically, only to the page as a whole -->
    <h1>Posting</h1>
    <p>While I'm thinking about it, I wanted to say something about
    posting. Posting is fun!</p>
  </aside>
  <footer>
    <p><a href="/first-post" rel=bookmark>Permalink</a>
  </footer>
</article>
<footer>
  <p><a href="/archives">Archives</a> -
    <a href="/about">About me</a> -
    <a href="/copyright">Copyright</a></p>
</footer>
</body>
```

4.3.6 The ***h1***, ***h2***, ***h3***, ***h4***, ***h5***, and ***h6*** elements

✓MDN

[Element/Heading_Elements](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Element/Heading_Elements](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Element/Heading_Elements](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Element/Heading_Elements](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Element/Heading_Elements](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Element/Heading_Elements](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

✓MDN

[HTMLHeadingElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content.](#)

[Heading content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

As a child of an [hgroup](#) element.

Where [heading content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLHeadingElement : HTMLElement {
    [HTMLConstructor] constructor();
    // also has obsolete members
};
```

These elements [represent](#) headings for their sections.

The semantics and meaning of these elements are defined in the section on [headings and sections](#).

These elements have a *rank* given by the number in their name. The [h1](#) element is said to have the highest rank, the [h6](#) element has the lowest rank, and two elements with the same name have equal rank.

As far as their respective document outlines (their heading and section structures) are concerned, these two snippets are semantically equivalent:

```
<body>
<h1>Let's call it a draw(ing surface)</h1>
<h2>Diving in</h2>
<h2>Simple shapes</h2>
<h2>Canvas coordinates</h2>
<h3>Canvas coordinates diagram</h3>
<h2>Paths</h2>
</body>
```

```
<body>
  <h1>Let's call it a draw(ing surface)</h1>
  <section>
    <h1>Diving in</h1>
  </section>
  <section>
    <h1>Simple shapes</h1>
  </section>
  <section>
    <h1>Canvas coordinates</h1>
    <section>
      <h1>Canvas coordinates diagram</h1>
    </section>
  </section>
</body>
```

```
</section>
<section>
  <h1>Paths</h1>
</section>
</body>
```

Authors might prefer the former style for its terseness, or the latter style for its convenience in the face of heavy editing; which is best is purely an issue of preferred authoring style.

The two styles can be combined, for compatibility with legacy tools while still future-proofing for when that compatibility is no longer needed. This third snippet again has the same outline as the previous two:

```
<body>
  <h1>Let's call it a draw(ing surface)</h1>
  <section>
    <h2>Diving in</h2>
  </section>
  <section>
    <h2>Simple shapes</h2>
  </section>
  <section>
    <h2>Canvas coordinates</h2>
    <section>
      <h3>Canvas coordinates diagram</h3>
    </section>
  </section>
  <section>
    <h2>Paths</h2>
  </section>
</body>
```

4.3.7 The ***hgroup*** element



[Element/hgroup](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 4.2+ Chrome Android Yes WebView Android 2.2+ Samsung Internet Yes Opera Android 11.1+

Categories:

Flow content.

Heading content.

Palpable content.

Contexts in which this element can be used:

Where heading content is expected.

Content model:

One or more [h1](#), [h2](#), [h3](#), [h4](#), [h5](#), [h6](#) elements, optionally intermixed with script-supporting elements.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTMLElement](#).

The [hgroup](#) element represents the heading of a section, which consists of all the [h1–h6](#) element children of the [hgroup](#) element. The element is used to group a set of [h1–h6](#) elements when the heading has multiple levels, such as subheadings, alternative titles, or taglines.

The [rank](#) of an [hgroup](#) element is the rank of the highest-ranked [h1–h6](#) element descendant of the [hgroup](#) element, if there are any such elements, or otherwise the same as for an [h1](#) element (the highest rank). Other [h1–h6](#) elements of heading content in the [hgroup](#) element indicate subheadings or subtitles or (secondary) alternative titles.

The section on [headings and sections](#) defines how [hgroup](#) elements are assigned to individual sections.

Here are some examples of valid headings.

```
<hgroup>
  <h1>The reality dysfunction</h1>
  <h2>Space is not the only void</h2>
</hgroup>
```

```
<hgroup>
  <h1>Dr. Strangelove</h1>
```

```
<h2>Or: How I Learned to Stop Worrying and Love the Bomb</h2>
</hgroup>
```

The point of using [hgroup](#) in these examples is to prevent the [h2](#) element (which acts as a secondary title) from creating a separate section of its own in any [outline](#) and to instead cause the contents of the [h2](#) to be shown in rendered output from the [outline](#) algorithm in some way to indicate that it is not the title of a separate section but instead just a secondary title in a group of titles.

How a user agent exposes such multi-level headings in user interfaces (e.g. in tables of contents or search results) is left open to implementers, as it is a user interface issue. The first example above could be rendered as:

The reality dysfunction: Space is not the only void

Alternatively, it could look like this:

The reality dysfunction (Space is not the only void)

In interfaces where a title can be rendered on multiple lines, it could be rendered as follows, maybe with the first line in a bigger font size:

**The reality dysfunction
Space is not the only void**

The following two examples show ways in which two [h1](#) headings could be used within an [hgroup](#) element to group the US and UK names for the same movie.

```
<hgroup>
  <h1>The Avengers</h1>
  <h1>Avengers Assemble</h1>
</hgroup>
```

```
<hgroup>
  <h1>Avengers Assemble</h1>
  <h1>The Avengers</h1>
</hgroup>
```

The first example above shows how the movie names might be grouped in a publication in the US, with the US name *The Avengers* as the (primary) title, and the UK name *Avengers Assemble* as the (secondary) alternative title. The second example above shows how the movie names might be grouped in a publication in the UK, with the UK name as the (primary) title, and the US name as the (secondary) alternative title.

In both cases it is important to note the use of the [hgroup](#) element to group the two titles indicates that the titles are not equivalent; instead the first [h1](#) gives the (primary) title while the second gives the (secondary) alternative title. Even though both the title and alternative

title are marked up with `h1` elements, in a rendered view of output from the [outline](#) algorithm, the second `h1` in the `hgroup` will be shown in some way that clearly indicates it is secondary; for example:

In a US publication:

The Avengers (Avengers Assemble)

In a UK publication:

Avengers Assemble (The Avengers)

In the following example, an `hgroup` element is used to mark up a two-level heading in a wizard-style dialog box:

```
<dialog onclose="walletSetup.continue(this.returnValue)">
  <hgroup>
    <h1>Wallet Setup</h1>
    <h2>Configure your Wallet funding source</h2>
  </hgroup>
  <p>Your Wallet can be used to buy wands at the merchant in town, to buy potions from salesmen you may find in the dungeons, and to pay for mercenaries.</p>
  <p>We support two payment sources:</p>
  <form method=dialog>
    <fieldset oninput="this.getElementsByName('input')[0].checked = true">
      <legend> <label> <input type=radio name=payment-type value=cc> Credit Card
      <p><label>Name on card: <input name=cc1 autocomplete="section-cc cc-name" type=text>
      <p><label>Card number: <input name=cc2 inputmode=numeric autocomplete="section-cc cc-number" type=text>
      <p><label>Expiry Date: <input name=cc3 type=month autocomplete="section-cc cc-exp" type=text>
      <p><label>Security Code: <input name=cc4 inputmode=numeric autocomplete="section-cc cc-csc" type=text>
    </fieldset>
    <fieldset oninput="this.getElementsByName('input')[0].checked = true">
      <legend> <label> <input type=radio name=payment-type value=bank> Checking Account
      <p><label>Name on account: <input name=bank1 autocomplete="section-bank cc-name" type=text>
      <p><label>Routing number: <input name=bank2 inputmode=numeric></label>
      <p><label>Account number: <input name=bank3 inputmode=numeric></label>
    </fieldset>
    <button type=submit value="back"> ← Back </button>
    <button type=submit value="next"> Next → </button>
  </form>
</dialog>
```

4.3.8 The `header` element



[Element/header](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 4.2+ Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android 11.1+

Categories:

[Flow content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [flow content](#) is expected.

Content model:

[Flow content](#), but with no [header](#) or [footer](#) element descendants.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

If the nearest ancestor [sectioning content](#) or [sectioning root](#) element is [the body element for authors; for implementers](#).

Otherwise: [for authors; for implementers](#).

DOM interface:

Uses [HTMLElement](#).

The [header](#) element [represents](#) a group of introductory or navigational aids.

A [header](#) element is intended to usually contain the section's heading (an [h1–h6](#) element or an [hgroup](#) element), but this is not required. The [header](#) element can also be used to wrap a section's table of contents, a search form, or any relevant logos.

Here are some sample headers. This first one is for a game:

```
<header>
  <p>Welcome to...</p>
  <h1>Voidwars!</h1>
</header>
```

The following snippet shows how the element can be used to mark up a specification's header:

```
<header>
  <hgroup>
    <h1>Fullscreen API</h1>
    <h2>Living Standard – Last Updated 19 October 2015</h2>
  </hgroup>
  <dl>
    <dt>Participate:</dt>
    <dd><a href="https://github.com/whatwg/fullscreen">GitHub whatwg/fullscreen</a></dd>
    <dt>Commits:</dt>
    <dd><a href="https://github.com/whatwg/fullscreen/commits">GitHub whatwg/fullscreen/commits</a></dd>
  </dl>
</header>
```

The [header](#) element is not [sectioning content](#); it doesn't introduce a new section.

In this example, the page has a page heading given by the [h1](#) element, and two subsections whose headings are given by [h2](#) elements. The content after the [header](#) element is still part of the last subsection started in the [header](#) element, because the [header](#) element doesn't take part in the [outline](#) algorithm.

```
<body>
  <header>
    <h1>Little Green Guys With Guns</h1>
    <nav>
      <ul>
        <li><a href="/games">Games</a>
        <li><a href="/forum">Forum</a>
        <li><a href="/download">Download</a>
      </ul>
    </nav>
    <h2>Important News</h2> <!-- this starts a second subsection -->
    <!-- this is part of the subsection entitled "Important News" -->
    <p>To play today's games you will need to update your client.</p>
    <h2>Games</h2> <!-- this starts a third subsection -->
  </header>
  <p>You have three active games:</p>
  <!-- this is still part of the subsection entitled "Games" -->
  ...

```

4.3.9 The **footer** element



[Element/footer](#)

Support in all current engines.

Firefox4+Safari5+Chrome5+

Opera11.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS4.2+Chrome AndroidYesWebView AndroidYesSamsung InternetYesOpera Android11.1+

Categories:

[Flow content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [flow content](#) is expected.

Content model:

[Flow content](#), but with no [header](#) or [footer](#) element descendants.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

If the nearest ancestor [sectioning content](#) or [sectioning root](#) element is [the body element](#); [for authors](#); [for implementers](#).

Otherwise: [for authors](#); [for implementers](#).

DOM interface:

Uses [HTMLElement](#).

The [footer](#) element represents a footer for its nearest ancestor [sectioning content](#) or [sectioning root](#) element. A footer typically contains information about its section such as who wrote it, links to related documents, copyright data, and the like.

When the [footer](#) element contains entire sections, they represent appendices, indices, long colophons, verbose license agreements, and other such content.

Contact information for the author or editor of a section belongs in an [address](#) element, possibly itself inside a [footer](#). Bylines and other information that could be suitable for both a [header](#) or a [footer](#) can be placed in either (or neither). The primary purpose of these elements is merely to help the author write self-explanatory markup that is easy to maintain and style; they are not intended to impose specific structures on authors.

Footers don't necessarily have to appear at the *end* of a section, though they usually do.

When the nearest ancestor [sectioning content](#) or [sectioning root](#) element is [the body element](#), then it applies to the whole page.

The [footer](#) element is not [sectioning content](#); it doesn't introduce a new section.

Here is a page with two footers, one at the top and one at the bottom, with the same content:

```
<body>
<footer><a href=". /">Back to index...</a></footer>
<hgroup>
  <h1>Lorem ipsum</h1>
  <h2>The ipsum of all lorem</h2>
</hgroup>
<p>A dolor sit amet, consectetur adipisicing elit, sed do eiusmod
tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim
veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex
ea commodo consequat. Duis aute irure dolor in reprehenderit in
voluptate velit esse cillum dolore eu fugiat nulla
pariatur. Excepteur sint occaecat cupidatat non proident, sunt in
culpa qui officia deserunt mollit anim id est laborum.</p>
<footer><a href=". /">Back to index...</a></footer>
</body>
```

Here is an example which shows the [footer](#) element being used both for a site-wide footer and for a section footer.

```
<!DOCTYPE HTML>
<HTML LANG="en"><HEAD>
<TITLE>The Ramblings of a Scientist</TITLE>
<BODY>
<H1>The Ramblings of a Scientist</H1>
<ARTICLE>
  <H1>Episode 15</H1>
  <VIDEO SRC="/fm/015.ogv" CONTROLS PRELOAD>
    <P><A HREF="/fm/015.ogv">Download video</A>.</P>
  </VIDEO>
  <FOOTER> <!-- footer for article -->
    <P>Published <TIME DATETIME="2009-10-21T18:26-07:00">on 2009/10/21 at 6:26pm</P>
  </FOOTER>
</ARTICLE>
<ARTICLE>
  <H1>My Favorite Trains</H1>
  <P>I love my trains. My favorite train of all time is a Köf.</P>
  <P>It is fun to see them pull some coal cars because they look so
dwarfed in comparison.</P>
  <FOOTER> <!-- footer for article -->
    <P>Published <TIME DATETIME="2009-09-15T14:54-07:00">on 2009/09/15 at 2:54pm</P>
  </FOOTER>
</ARTICLE>
<FOOTER> <!-- site wide footer -->
```

```

<NAV>
  <P><A HREF="/credits.html">Credits</A> –
    <A HREF="/tos.html">Terms of Service</A> –
    <A HREF="/index.html">Blog Index</A></P>
</NAV>
<P>Copyright © 2009 Gordon Freeman</P>
</FOOTER>
</BODY>
</HTML>

```

Some site designs have what is sometimes referred to as "fat footers" — footers that contain a lot of material, including images, links to other articles, links to pages for sending feedback, special offers... in some ways, a whole "front page" in the footer.

This fragment shows the bottom of a page on a site with a "fat footer":

```

...
<footer>
  <nav>
    <section>
      <h1>Articles</h1>
      <p> Go to the gym with
        our somersaults class! Our teacher Jim takes you through the paces
        in this two-part article. <a href="articles/somersaults/1">Part
        1</a> · <a href="articles/somersaults/2">Part 2</a></p>
      <p> Tired of walking on the edge of
        a cliff!-- sic --? Our guest writer Lara shows you how to bumble
        your way through the bars. <a href="articles/kindplus/1">Read
        more...</a></p>
      <p> The chips are down, now all
        that's left is a potato. What can you do with it? <a
        href="articles/crisps/1">Read more...</a></p>
    </section>
    <ul>
      <li> <a href="/about">About us...</a>
      <li> <a href="/feedback">Send feedback!</a>
      <li> <a href="/sitemap">Sitemap</a>
    </ul>
  </nav>
  <p><small>Copyright © 2015 The Snacker –
    <a href="/tos">Terms of Service</a></small></p>
</footer>
</body>

```

4.3.10 The **address** element



Element/address

Support in all current engines.

Firefox 1+ Safari 1+ Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

Flow content.

Palpable content.

Contexts in which this element can be used:

Where flow content is expected.

Content model:

Flow content, but with no heading content descendants, no sectioning content descendants, and no header, footer, or address element descendants.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses HTMLElement.

The address element represents the contact information for its nearest article or body element ancestor. If that is the body element, then the contact information applies to the document as a whole.

For example, a page at the W3C web site related to HTML might include the following contact information:

```
<ADDRESS>
<A href=". /People/Raggett/">Dave Raggett</A>,
```

```
<A href=". /People/Arnaud/">Arnaud Le Hors</A>,
contact persons for the <A href="Activity">W3C HTML Activity</A>
</ADDRESS>
```

The [address](#) element must not be used to represent arbitrary addresses (e.g. postal addresses), unless those addresses are in fact the relevant contact information. (The [p](#) element is the appropriate element for marking up postal addresses in general.)

The [address](#) element must not contain information other than contact information.

For example, the following is non-conforming use of the [address](#) element:

```
<ADDRESS>Last Modified: 1999/12/24 23:37:50</ADDRESS>
```

Typically, the [address](#) element would be included along with other information in a [footer](#) element.

The contact information for a node *node* is a collection of [address](#) elements defined by the first applicable entry from the following list:

If *node* is an [article](#) element

If *node* is a [body](#) element

The contact information consists of all the [address](#) elements that have *node* as an ancestor and do not have another [body](#) or [article](#) element ancestor that is a descendant of *node*.

If *node* has an ancestor element that is an [article](#) element

If *node* has an ancestor element that is a [body](#) element

The contact information of *node* is the same as the contact information of the nearest [article](#) or [body](#) element ancestor, whichever is nearest.

If *node*'s [node document](#) has a [body](#) element

The contact information of *node* is the same as the contact information of [the body element](#) of the [Document](#).

Otherwise

There is no contact information for *node*.

User agents may expose the contact information of a node to the user, or use it for other purposes, such as indexing sections based on the sections' contact information.

In this example the footer contains contact information and a copyright notice.

```
<footer>
```

```
<address>
  For more details, contact
  <a href="mailto:js@example.com">John Smith</a>.
</address>
<p><small>© copyright 2038 Example Corp.</small></p>
</footer>
```

4.3.11 Headings and sections

The [h1–h6](#) elements and the [hgroup](#) element are headings.

The first element of [heading content](#) in an element of [sectioning content](#) [represents](#) the heading for that section. Subsequent headings of equal or higher [rank](#) start new (implied) sections, headings of lower [rank](#) start implied subsections that are part of the previous one. In both cases, the element [represents](#) the heading of the implied section.

Certain elements are said to be *sectioning roots*, including [blockquote](#) and [td](#) elements. These elements can have their own outlines, but the sections and headings inside these elements do not contribute to the outlines of their ancestors.

- [blockquote](#)
- [body](#)
- [details](#)
- [dialog](#)
- [fieldset](#)
- [figure](#)
- [td](#)

[Sectioning content](#) elements are always considered subsections of their nearest ancestor [sectioning root](#) or their nearest ancestor element of [sectioning content](#), whichever is nearest, regardless of what implied sections other headings may have created.

For the following fragment:

```
<body>
  <h1>Foo</h1>
  <h2>Bar</h2>
  <blockquote>
    <h3>Bla</h3>
  </blockquote>
  <p>Baz</p>
  <h2>Quux</h2>
  <section>
    <h3>Thud</h3>
  </section>
  <p>Grunt</p>
</body>
```

...the structure would be:

1. Foo (heading of explicit **body** section, containing the "Grunt" paragraph)
 1. Bar (heading starting implied section, containing a block quote and the "Baz" paragraph)
 2. Quux (heading starting implied section with no content other than the heading itself)
 3. Thud (heading of explicit **section** section)

Notice how the **section** ends the earlier implicit section so that a later paragraph ("Grunt") is back at the top level.

Sections may contain headings of any **rank**, but authors are strongly encouraged to either use only **h1** elements, or to use elements of the appropriate **rank** for the section's nesting level.

Authors are also encouraged to explicitly wrap sections in elements of **sectioning content**, instead of relying on the implicit sections generated by having multiple headings in one element of **sectioning content**.

For example, the following is correct:

```
<body>
  <h4>Apples</h4>
  <p>Apples are fruit.</p>
  <section>
    <h2>Taste</h2>
    <p>They taste lovely.</p>
    <h6>Sweet</h6>
    <p>Red apples are sweeter than green ones.</p>
    <h1>Color</h1>
    <p>Apples come in various colors.</p>
  </section>
</body>
```

However, the same document would be more clearly expressed as:

```
<body>
  <h1>Apples</h1>
  <p>Apples are fruit.</p>
  <section>
    <h2>Taste</h2>
    <p>They taste lovely.</p>
    <section>
      <h3>Sweet</h3>
      <p>Red apples are sweeter than green ones.</p>
    </section>
  </section>
</body>
```

```
<section>
  <h2>Color</h2>
  <p>Apples come in various colors.</p>
</section>
</body>
```

Both of the documents above are semantically identical and would produce the same outline in compliant user agents.

This third example is also semantically identical, and might be easier to maintain (e.g. if sections are often moved around in editing):

```
<body>
  <h1>Apples</h1>
  <p>Apples are fruit.</p>
  <section>
    <h1>Taste</h1>
    <p>They taste lovely.</p>
    <section>
      <h1>Sweet</h1>
      <p>Red apples are sweeter than green ones.</p>
    </section>
  </section>
  <section>
    <h1>Color</h1>
    <p>Apples come in various colors.</p>
  </section>
</body>
```

This final example would need explicit style rules to be rendered well in legacy browsers. Legacy browsers without CSS support would render all the headings as top-level headings.

4.3.11.1 Creating an outline

This section defines an algorithm for creating an outline for a [sectioning content](#) element or a [sectioning root](#) element. It is defined in terms of a walk over the nodes of a DOM tree, in [tree order](#), with each node being visited when it is *entered* and when it is *exited* during the walk.

The *outline* for a [sectioning content](#) element or a [sectioning root](#) element consists of a list of one or more potentially nested [sections](#). The element for which an [outline](#) is created is said to be *the outline's owner*.

A *section* is a container that corresponds to some nodes in the original DOM tree. Each section can have one heading associated with it, and can contain any number of further nested sections. The algorithm for the outline also associates each node in the DOM tree with a particular section and potentially a heading. (The sections in the outline aren't [section](#) elements, though some may correspond to such elements — they are merely conceptual

sections.)

The following markup fragment:

```
<body>
  <hgroup id="document-title">
    <h1>HTML</h1>
    <h2>Living Standard – Last Updated 12 August 2016</h2>
  </hgroup>
  <p>Some intro to the document.</p>
  <h2>Table of contents</h2>
  <ol id=toc>...</ol>
  <h2>First section</h2>
  <p>Some intro to the first section.</p>
</body>
```

...results in the following outline being created for the **body** node (and thus the entire document):

1. Section created for **body** node.

Associated with heading `<hgroup id="document-title">...</hgroup>` consisting of primary heading `<h1>HTML</h1>` and secondary heading `<h2>Living Standard – Last Updated 12 August 2016</h2>`.

Also associated with the paragraph `<p>Some intro to the document.</p>` (though it likely would not be shown in a rendered view of the outline).

Nested sections:

1. Section implied for first **h2** element.

Associated with heading `<h2>Table of contents</h2>`.

Also associated with the ordered list `<ol id=toc>...` (though it likely would not be shown in a rendered view of the outline).

No nested sections.

2. Section implied for second **h2** element.

Associated with heading `<h2>First section</h2>`.

Also associated with the paragraph `<p>Some intro to the first section.</p>` (though it likely would not be shown in a rendered view of the outline).

No nested sections.

The following image shows what a rendered view of the outline might look like.

HTML: Living Standard — Last Updated 12 August 2016



The algorithm that must be followed during a walk of a DOM subtree rooted at a [sectioning content](#) element or a [sectioning root](#) element to determine that element's [outline](#) is as follows:

1. Let *current outline target* be null. (It holds the element whose [outline](#) is being created.)
2. Let *current section* be null. (It holds a pointer to a [section](#), so that elements in the DOM can all be associated with a section.)
3. Create a stack to hold elements, which is used to handle nesting. Initialize this stack to empty.
4. Walk over the DOM in [tree order](#), starting with the [sectioning content](#) element or [sectioning root](#) element at the root of the subtree for which an outline is to be created, and trigger the first relevant step below for each element as the walk enters and exits it.

When exiting an element, if that element is the element at the top of the stack

The element being exited is a [heading content](#) element or an element with a [hidden](#) attribute.

Pop that element from the stack.

If the top of the stack is a [heading content](#) element or an element with a [hidden](#) attribute

Do nothing.

When entering an element with a [hidden](#) attribute

Push the element being entered onto the stack. (This causes the algorithm to skip that element and any descendants of the element.)

When entering a [sectioning content](#) element

Run these steps:

1. If *current outline target* is not null, then:
 1. If the *current section* has no heading, create an implied heading and let that be the heading for the *current section*.
 2. Push *current outline target* onto the stack.
2. Let *current outline target* be the element that is being entered.
3. Let *current section* be a newly created [section](#) for the *current outline target* element.
4. Associate *current outline target* with *current section*.
5. Let there be a new [outline](#) for the new *current outline target*, initialized with just the new *current section* as the only [section](#) in the outline.

When exiting a [sectioning content](#) element, if the stack is not empty

Run these steps:

1. If the *current section* has no heading, create an implied heading and let that be the heading for the *current section*.
2. Pop the top element from the stack, and let the *current outline target* be that element.
3. Let *current section* be the last section in the [outline](#) of the *current outline target* element.
4. Append the [outline](#) of the [sectioning content](#) element being exited to the *current section*. (This does not change which section is the last section in the [outline](#).)

When entering a [sectioning root](#) element

Run these steps:

1. If *current outline target* is not null, push *current outline target* onto the stack.
2. Let *current outline target* be the element that is being entered.
3. Let *current outline target's parent section* be *current section*.
4. Let *current section* be a newly created [section](#) for the *current outline target* element.

5. Let there be a new [outline](#) for the new *current outline target*, initialized with just the new *current section* as the only [section](#) in the outline.

When exiting a [sectioning root](#) element, if the stack is not empty

Run these steps:

1. If the *current section* has no heading, create an implied heading and let that be the heading for the *current section*.
2. Let *current section* be *current outline target's parent section*.
3. Pop the top element from the stack, and let the *current outline target* be that element.

When exiting a [sectioning content](#) element or a [sectioning root](#) element (when the stack is empty)

The *current outline target* is the element being exited, and it is the [sectioning content](#) element or a [sectioning root](#) element at the root of the subtree for which an outline is being generated.

If the *current section* has no heading, create an implied heading and let that be the heading for the *current section*.

Skip to the next step in the overall set of steps. (The walk is over.)

When entering a [heading content](#) element

If the *current section* has no heading, let the element being entered be the heading for the *current section*.

If the element being entered is an [hgroup](#) element, that [hgroup](#) as a whole is a *multi-level* heading for the *current section*, with the highest-ranked [h1–h6](#) descendant of the [hgroup](#) providing the primary heading for the *current section*, and with other [h1–h6](#) descendants of the [hgroup](#) providing secondary headings for the *current section*.

Otherwise, if the element being entered has a [rank](#) equal to or higher than the heading of the last section of the [outline](#) of the *current outline target*, or if the heading of the last section of the [outline](#) of the *current outline target* is an implied heading, then create a new [section](#) and append it to the [outline](#) of the *current outline target* element, so that this new section is the new last section of that outline. Let *current section* be that new section. Let the element being entered be the new heading for the *current section*.

Otherwise, run these substeps:

1. Let *candidate section* be *current section*.
2. *Heading loop*: If the element being entered has a [rank](#) lower than the [rank](#) of the heading of the *candidate section*, then create a new [section](#), and append it to *candidate section*. (This does not change which section is the last section in the outline.) Let *current section* be this new section. Let the element being entered be the new heading for the *current section*. Abort these substeps.
3. Let *new candidate section* be the [section](#) that contains *candidate section* in the [outline](#) of *current outline target*.
4. Let *candidate section* be *new candidate section*.
5. Return to the step labeled *heading loop*.

Push the element being entered onto the stack. (This causes the algorithm to skip any descendants of the element.)

Recall that [h1](#) has the *highest* rank, and [h6](#) has the lowest rank.

Otherwise

Do nothing.

In addition, whenever the walk exits a node, after doing the steps above, if the node is not associated with a [section](#) yet, associate the node with the [section](#) *current section*.

5. Associate all non-element nodes that are in the subtree for which an outline is being created with the [section](#) with which their parent element is associated.
6. Associate all nodes in the subtree with the heading of the [section](#) with which they are associated, if any.

The tree of sections created by the algorithm above, or a proper subset thereof, must be used when generating document outlines, for example when generating tables of contents.

The outline created for [the body element](#) of a [Document](#) is the [outline](#) of the entire document.

When creating an interactive table of contents, entries should jump the user to the relevant [sectioning content](#) element, if the [section](#) was created for a real element in the original document, or to the relevant [heading content](#) element, if the [section](#) in the tree was generated for a heading in the above process.

Selecting the first [section](#) of the document therefore always takes the user to the top of the document, regardless of where the first heading in the [body](#) is to be found.

The *outline depth* of a [heading content](#) element associated with a [section](#) *section* is the number

of [sections](#) that are ancestors of [section](#) in the outermost [outline](#) that [section](#) finds itself in when the [outlines](#) of its [Document](#)'s elements are created, plus 1. The [outline depth](#) of a [heading content](#) element not associated with a [section](#) is 1.

User agents should provide default headings for sections that do not have explicit section headings.

Consider the following snippet:

```
<body>
  <nav>
    <p><a href="/">Home</a></p>
  </nav>
  <p>Hello world.</p>
  <aside>
    <p>My cat is cute.</p>
  </aside>
</body>
```

Although it contains no headings, this snippet has three sections: a document (the [body](#)) with two subsections (a [nav](#) and an [aside](#)). A user agent could present the outline as follows:

1. Untitled document
 1. Navigation
 2. Sidebar

These default headings ("Untitled document", "Navigation", "Sidebar") are not specified by this specification, and might vary with the user's language, the page's language, the user's preferences, the user agent implementer's preferences, etc.

The following JavaScript function shows how the tree walk could be implemented. The [root](#) argument is the root of the tree to walk (either a [sectioning content](#) element or a [sectioning root](#) element), and the [enter](#) and [exit](#) arguments are callbacks that are called with the nodes as they are entered and exited. [\[JAVASCRIPT\]](#)

```
function (root, enter, exit) {
  var node = root;
  start: while (node) {
    enter(node);
    if (node.firstChild) {
      node = node.firstChild;
      continue start;
    }
    while (node) {
      exit(node);
      if (node == root) {
        node = null;
      }
    }
  }
}
```

```

        } else if (node.nextSibling) {
            node = node.nextSibling;
            continue start;
        } else {
            node = node.parentNode;
        }
    }
}
}

```

4.3.11.2 Sample outlines

This section is non-normative.

The following document shows a straight-forward application of the [outline](#) algorithm. First, here is the document, which is a book with very short chapters and subsections:

```

<!DOCTYPE HTML>
<html lang=en>
<title>The Tax Book (all in one page)</title>
<h1>The Tax Book</h1>
<h2>Earning money</h2>
<p>Earning money is good.</p>
<h3>Getting a job</h3>
<p>To earn money you typically need a job.</p>
<h2>Spending money</h2>
<p>Spending is what money is mainly used for.</p>
<h3>Cheap things</h3>
<p>Buying cheap things often not cost-effective.</p>
<h3>Expensive things</h3>
<p>The most expensive thing is often not the most cost-effective either.</p>
<h2>Investing money</h2>
<p>You can lend your money to other people.</p>
<h2>Losing money</h2>
<p>If you spend money or invest money, sooner or later you will lose money.
<h3>Poor judgement</h3>
<p>Usually if you lose money it's because you made a mistake.</p>

```

This book would form the following outline:

1. The Tax Book
 1. Earning money
 1. Getting a job
 2. Spending money
 1. Cheap things
 2. Expensive things
 3. Investing money

4. Losing money
 1. Poor judgement

Notice that the **title** element does not participate in the outline.

Here is a similar document, but this time using **section** elements to get the same effect:

```
<!DOCTYPE HTML>
<html lang=en>
<title>The Tax Book (all in one page)</title>
<h1>The Tax Book</h1>
<section>
  <h1>Earning money</h1>
  <p>Earning money is good.</p>
  <section>
    <h1>Getting a job</h1>
    <p>To earn money you typically need a job.</p>
  </section>
</section>
<section>
  <h1>Spending money</h1>
  <p>Spending is what money is mainly used for.</p>
  <section>
    <h1>Cheap things</h1>
    <p>Buying cheap things often not cost-effective.</p>
  </section>
  <section>
    <h1>Expensive things</h1>
    <p>The most expensive thing is often not the most cost-effective either.</p>
  </section>
</section>
<section>
  <h1>Investing money</h1>
  <p>You can lend your money to other people.</p>
</section>
<section>
  <h1>Losing money</h1>
  <p>If you spend money or invest money, sooner or later you will lose money.
  <section>
    <h1>Poor judgement</h1>
    <p>Usually if you lose money it's because you made a mistake.</p>
  </section>
</section>
```

This book would form the same outline:

1. The Tax Book

1. Earning money
 1. Getting a job
2. Spending money
 1. Cheap things
 2. Expensive things
3. Investing money
4. Losing money
 1. Poor judgement

A document can contain multiple top-level headings:

```
<!DOCTYPE HTML>
<html lang=en>
<title>Alphabetic Fruit</title>
<h1>Apples</h1>
<p>Pomaceous.</p>
<h1>Bananas</h1>
<p>Edible.</p>
<h1>Carambola</h1>
<p>Star.</p>
```

This would form the following simple outline consisting of three top-level sections:

1. Apples
2. Bananas
3. Carambola

Effectively, the [body](#) element is split into three.

Mixing both the [h1–h6](#) model and the [section/h1](#) model can lead to some unintuitive results.

Consider for example the following, which is just the previous example but with the contents of the (implied) [body](#) wrapped in a [section](#):

```
<!DOCTYPE HTML>
<html lang=en>
<title>Alphabetic Fruit</title>
<section>
  <h1>Apples</h1>
  <p>Pomaceous.</p>
  <h1>Bananas</h1>
  <p>Edible.</p>
  <h1>Carambola</h1>
  <p>Star.</p>
</section>
```

The resulting outline would be:

1. (*untitled page*)
 1. Apples
 2. Bananas
 3. Carambola

This result is described as *unintuitive* because it results in three subsections even though there's only one **section** element. Effectively, the **section** is split into three, just like the implied **body** element in the previous example.

(In this example, "*(untitled page)*" is the implied heading for the **body** element, since it has no explicit heading.)

Headings never rise above other sections. Thus, in the following example, the first **h1** does not actually describe the page header; it describes the header for the second half of the page:

```
<!DOCTYPE HTML>
<html lang=en>
<title>Feathers on The Site of Encyclopedic Knowledge</title>
<section>
  <h1>A plea from our caretakers</h1>
  <p>Please, we beg of you, send help! We're stuck in the server room!</p>
</section>
<h1>Feathers</h1>
<p>Epidermal growths.</p>
```

The resulting outline would be:

1. (*untitled page*)
 1. A plea from our caretakers
2. Feathers

Thus, when an **article** element starts with a **nav** block and only later has its heading, the result is that the **nav** block is not part of the same section as the rest of the **article** in the outline. For instance, take this document:

```
<!DOCTYPE HTML>
<html lang="en">
<title>We're adopting a child! – Ray's blog</title>
<h1>Ray's blog</h1>
<article>
  <header>
    <nav>
      <a href="?t=-1d">Yesterday</a>;
      <a href="?t=-7d">Last week</a>;
      <a href="?t=-1m">Last month</a>
    </nav>
    <h1>We're adopting a child!</h1>
```

```
</header>
<p>As of today, Janine and I have signed the papers to become
the proud parents of baby Diane! We've been looking forward to
this day for weeks.</p>
</article>
</html>
```

The resulting outline would be:

1. Ray's blog
 1. *Untitled article*
 1. *Untitled navigation section*
 2. We're adopting a child!

Also worthy of note in this example is that the [header](#) element has no effect whatsoever on the document outline.

The [hgroup](#) element can be used for subheadings. For example:

```
<!DOCTYPE HTML>
<html lang="en">
<title>Chronotype: CS Student</title>
<hgroup>
  <h1> The morning </h1>
  <h2> 06:00 to 12:00 </h2>
</hgroup>
<p>We sleep.</p>
<hgroup>
  <h1> The afternoon </h1>
  <h2> 12:00 to 18:00 </h2>
</hgroup>
<p>We study.</p>
<hgroup>
  <h2>Additional Commentary</h2>
  <h3>Because not all this is necessarily true</h3>
  <h6>Ok it's almost certainly not true</h6>
</hgroup>
<p>Yeah we probably play, rather than study.</p>
<hgroup>
  <h1> The evening </h1>
  <h2> 18:00 to 00:00 </h2>
</hgroup>
<p>We play.</p>
<hgroup>
  <h1> The night </h1>
  <h2> 00:00 to 06:00 </h2>
</hgroup>
```

```
<p>We play some more.</p>
</html>
```

The resulting outline would be:

1. The morning 06:00 to 12:00
2. The afternoon 12:00 to 18:00
 1. Additional Commentary Because not all this is necessarily true Ok it's almost certainly not true
3. The evening 18:00 to 00:00
4. The night 00:00 to 06:00

Exactly how this is represented by user agents, as most interface issues, is left as a matter of implementation preference, but the key part is that the [hgroup](#)'s descendant [h1–h6](#) elements are what form the element's heading. Thus, the following would be equally valid:

1. The morning — 06:00 to 12:00
2. The afternoon — 12:00 to 18:00
 1. Additional Commentary — Because not all this is necessarily true — Ok it's almost certainly not true
3. The evening — 18:00 to 00:00
4. The night — 00:00 to 06:00

But so would the following:

1. The morning
2. The afternoon
 1. Additional Commentary
3. The evening
4. The night

The following would also be valid, though maybe less practical in most contexts:

1. The morning
06:00 to 12:00
2. The afternoon
12:00 to 18:00
 1. Additional Commentary
Because not all this is necessarily true
Ok it's almost certainly not true
3. The evening

18:00 to 00:00

4. The night

00:00 to 06:00

4.3.11.3 Exposing outlines to users

User agents are encouraged to expose page outlines to users to aid in navigation. This is especially true for non-visual media, e.g. screen readers.

However, to mitigate the difficulties that arise from authors misusing [sectioning content](#), user agents are also encouraged to offer a mode that navigates the page using [heading content](#) alone.

For instance, a user agent could map the arrow keys as follows:

Shift++ Left

Go to previous section, including subsections of previous sections

Shift++ Right

Go to next section, including subsections of the current section

Shift++ Up

Go to parent section of the current section

Shift++ Down

Go to next section, skipping subsections of the current section

Plus in addition, the user agent could map the **j** and **k** keys to navigating to the previous or next element of [heading content](#), regardless of the section's outline depth and ignoring sections with no headings.

4.3.12 Usage summary

This section is non-normative.

Element	Purpose Example
	The contents of the document.
body	<pre><!DOCTYPE HTML> <html lang="en"> <head> <title>Steve Hill's Home Page</title> </head> <body> <p>Hard Trance is My Life.</p> </body> </html></pre>

[article](#) A complete, or self-contained, composition in a document, page, application, or site and that is, i

Element	Purpose	Example
	syndication. This could be a forum post, a magazine or newspaper article, a blog entry, a user-submitted item of content.	
<article>		
		<p>My fave Masif tee so far!</p>
		<footer>Posted 2 days ago</footer>
</article>		
<article>		
		<p>Happy 2nd birthday Masif Saturdays!!!</p>
		<footer>Posted 3 weeks ago</footer>
</article>		
	A generic section of a document or application. A section, in this context, is a thematic grouping of content.	
		<h1>Biography</h1>
		<section>
		<h1>The facts</h1>
<u>section</u>		<p>1500+ shows, 14+ countries</p>
		</section>
		<section>
		<h1>2010/2011 figures per year</h1>
		<p>100+ shows, 8+ countries</p>
		</section>
	A section of a page that links to other pages or to parts within the page: a section with navigation links.	
		<nav>
<u>nav</u>		<p>Home
		<p>Bio
		<p>Discog
		</nav>
	A section of a page that consists of content that is tangentially related to the content around the main content. Such sections are often represented as sidebars in printed typography.	
		<h1>Music</h1>
<u>aside</u>		<p>As any burner can tell you, the event has a lot of trance.</p>
		<aside>You can buy the music we played at our playlist
		<p>This year we played a kind of trance that originated in Belgium, Germany, France, and the Netherlands.</p>
<u>h1-h6</u>	A section heading	

Element	Purpose Example
	<pre><h1>The Guide To Music On The Playa</h1> <h2>The Main Stage</h2> <p>If you want to play on a stage, you should bring one.</p> <h2>Amplified Music</h2> <p>Amplifiers up to 300W or 90dB are welcome.</p></pre> <p>The heading of a section, which consists of all the h1–h6 element children of the hgroup element. The heading has multiple levels, such as subheadings, alternative titles, or taglines.</p>
hgroup	<pre><hgroup> <h1>Burning Music</h1> <h2>The Guide To Music On The Playa</h2> </hgroup> <section> <hgroup> <h1>Main Stage</h1> <h2>The Fiction Of A Music Festival</h2> </hgroup> <p>If you want to play on a stage, you should bring one.</p> </section> <section> <hgroup> <h1>Loudness!</h1> <h2>Questions About Amplified Music</h2> </hgroup> <p>Amplifiers up to 300W or 90dB are welcome.</p> </section></pre> <p>A group of introductory or navigational aids.</p>
header	<pre><article> <header> <h1>Hard Trance is My Life</h1> <p>By DJ Steve Hill and Technikal</p> </header> <p>The album with the amusing punctuation has red artwork.</p> </article></pre> <p>A footer for its nearest ancestor sectioning content or sectioning root element. A footer typically links to related documents, copyright data, and the like.</p>
footer	<pre><article></pre>

Element	Purpose Example
	<pre><h1>Hard Trance is My Life</h1> <p>The album with the amusing punctuation has red artwork.</p> <footer> <p>Artists: DJ Steve Hill and Technikal</p> </footer> </article></pre>

4.3.12.1 Article or section?

This section is non-normative.

A [section](#) forms part of something else. An [article](#) is its own thing. But how does one know which is which? Mostly the real answer is "it depends on author intent".

For example, one could imagine a book with a "Granny Smith" chapter that just said "These juicy, green apples make a great filling for apple pies."; that would be a [section](#) because there'd be lots of other chapters on (maybe) other kinds of apples.

On the other hand, one could imagine a tweet or reddit comment or tumblr post or newspaper classified ad that just said "Granny Smith. These juicy, green apples make a great filling for apple pies."; it would then be [articles](#) because that was the whole thing.

A comment on an article is not part of the [article](#) on which it is commenting, therefore it is its own [article](#).

4.4 Grouping content

4.4.1 The **p** element



Element/p

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes



[HTMLParagraphElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected.

[Content model:](#)

[Phrasing content](#).

[Tag omission in text/html:](#)

A `p` element's [end tag](#) can be omitted if the `p` element is immediately followed by an [address](#), [article](#), [aside](#), [blockquote](#), [details](#), [div](#), [dl](#), [fieldset](#), [figcaption](#), [figure](#), [footer](#), [form](#), [h1](#), [h2](#), [h3](#), [h4](#), [h5](#), [h6](#), [header](#), [hgroup](#), [hr](#), [main](#), [menu](#), [nav](#), [ol](#), [p](#), [pre](#), [section](#), [table](#), or [ul](#) element, or if there is no more content in the parent element and the parent element is an [HTML element](#) that is not an [a](#), [audio](#), [del](#), [ins](#), [map](#), [noscript](#), or [video](#) element, or an [autonomous custom element](#).

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLParagraphElement : HTMLElement {
  [HTMLConstructor] constructor();
  // also has obsolete members
};
```

The `p` element [represents](#) a paragraph.

While paragraphs are usually represented in visual media by blocks of text that are physically

separated from adjacent blocks through blank lines, a style sheet or user agent would be equally justified in presenting paragraph breaks in a different manner, for instance using inline pilcrows (¶).

The following examples are conforming HTML fragments:

```
<p>The little kitten gently seated herself on a piece of  
carpet. Later in her life, this would be referred to as the time the  
cat sat on the mat.</p>  
  
<fieldset>  
  <legend>Personal information</legend>  
  <p>  
    <label>Name: <input name="n"></label>  
    <label><input name="anon" type="checkbox"> Hide from other users</label>  
  </p>  
  <p><label>Address: <textarea name="a"></textarea></label></p>  
</fieldset>  
  
<p>There was once an example from Femley,<br>  
Whose markup was of dubious quality.<br>  
The validator complained,<br>  
So the author was pained,<br>  
To move the error from the markup to the rhyming.</p>
```

The [p](#) element should not be used when a more specific element is more appropriate.

The following example is technically correct:

```
<section>  
  <!-- ... -->  
  <p>Last modified: 2001-04-23</p>  
  <p>Author: fred@example.com</p>  
</section>
```

However, it would be better marked-up as:

```
<section>  
  <!-- ... -->  
  <footer>Last modified: 2001-04-23</footer>  
  <address>Author: fred@example.com</address>  
</section>
```

Or:

```
<section>  
  <!-- ... -->  
  <footer>
```

```
<p>Last modified: 2001-04-23</p>
<address>Author: fred@example.com</address>
</footer>
</section>
```

List elements (in particular, [ol](#) and [ul](#) elements) cannot be children of [p](#) elements. When a sentence contains a bulleted list, therefore, one might wonder how it should be marked up.

For instance, this fantastic sentence has bullets relating to

- wizards,
- faster-than-light travel, and
- telepathy,

and is further discussed below.

The solution is to realize that a [paragraph](#), in HTML terms, is not a logical concept, but a structural one. In the fantastic example above, there are actually *five paragraphs* as defined by this specification: one before the list, one for each bullet, and one after the list.

The markup for the above example could therefore be:

```
<p>For instance, this fantastic sentence has bullets relating to</p>
<ul>
  <li>wizards,
  <li>faster-than-light travel, and
  <li>telepathy,
</ul>
<p>and is further discussed below.</p>
```

Authors wishing to conveniently style such "logical" paragraphs consisting of multiple "structural" paragraphs can use the [div](#) element instead of the [p](#) element.

Thus for instance the above example could become the following:

```
<div>For instance, this fantastic sentence has bullets relating to
<ul>
  <li>wizards,
  <li>faster-than-light travel, and
  <li>telepathy,
</ul>
and is further discussed below.</div>
```

This example still has five structural paragraphs, but now the author can style just the [div](#) instead of having to consider each part of the example separately.

4.4.2 The ***hr*** element

✓MDN

[Element/hr](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

✓MDN

[HTMLHRElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

Flow content.

[Contexts in which this element can be used:](#)

Where flow content is expected.

[Content model:](#)

Nothing.

[Tag omission in text/html:](#)

No end tag.

[Content attributes:](#)

Global attributes

[Accessibility considerations:](#)

For authors.

For implementers.

[DOM interface:](#)

[Exposed=Window]

```
interface HTMLHRElement : HTMLElement {  
    [HTMLConstructor] constructor();  
  
    // also has obsolete members  
};
```

The [hr](#) element [represents](#) a [paragraph](#)-level thematic break, e.g. a scene change in a story, or a transition to another topic within a section of a reference book.

The following fictional extract from a project manual shows two sections that use the [hr](#) element to separate topics within the section.

```
<section>  
    <h1>Communication</h1>  
    <p>There are various methods of communication. This section  
    covers a few of the important ones used by the project.</p>  
    <hr>  
    <p>Communication stones seem to come in pairs and have mysterious  
    properties:</p>  
    <ul>  
        <li>They can transfer thoughts in two directions once activated  
        if used alone.</li>  
        <li>If used with another device, they can transfer one's  
        consciousness to another body.</li>  
        <li>If both stones are used with another device, the  
        consciousnesses switch bodies.</li>  
    </ul>  
    <hr>  
    <p>Radios use the electromagnetic spectrum in the meter range and  
    longer.</p>  
    <hr>  
    <p>Signal flares use the electromagnetic spectrum in the  
    nanometer range.</p>  
</section>  
<section>  
    <h1>Food</h1>  
    <p>All food at the project is rationed:</p>  
    <dl>  
        <dt>Potatoes</dt>  
        <dd>Two per day</dd>  
        <dt>Soup</dt>  
        <dd>One bowl per day</dd>  
    </dl>  
    <hr>  
    <p>Cooking is done by the chefs on a set rotation.</p>  
</section>
```

There is no need for an [hr](#) element between the sections themselves, since the [section](#) elements and the [h1](#) elements imply thematic changes themselves.

The following extract from *Pandora's Star* by Peter F. Hamilton shows two paragraphs that precede a scene change and the paragraph that follows it. The scene change, represented in the printed book by a gap containing a solitary centered star between the second and third paragraphs, is here represented using the [hr](#) element.

```
<p>Dudley was ninety-two, in his second life, and fast approaching time for another rejuvenation. Despite his body having the physical age of a standard fifty-year-old, the prospect of a long degrading campaign within academia was one he regarded with dread. For a supposedly advanced civilization, the Intersolar Commonwealth could be appallingly backward at times, not to mention cruel.</p>
<p><i>Maybe it won't be that bad</i>, he told himself. The lie was comforting enough to get him through the rest of the night's shift.</p>
<hr>
<p>The Carlton AllLander drove Dudley home just after dawn. Like the astronomer, the vehicle was old and worn, but perfectly capable of doing its job. It had a cheap diesel engine, common enough on a semi-frontier world like Gralmond, although its drive array was a thoroughly modern photoneural processor. With its high suspension and deep-tread tyres it could plough along the dirt track to the observatory in all weather and seasons, including the metre-deep snow of Gralmond's winters.</p>
```

The [hr](#) element does not affect the document's [outline](#).

4.4.3 The **pre** element



[Element/pre](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLPreElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

Flow content.

Palpable content.

Contexts in which this element can be used:

Where flow content is expected.

Content model:

Phrasing content.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLPreElement : HTMLElement {
    [HTMLConstructor] constructor();
    // also has obsolete members
};
```

The **pre** element represents a block of preformatted text, in which structure is represented by typographic conventions rather than by elements.

In the HTML syntax, a leading newline character immediately following the **pre** element start tag is stripped.

Some examples of cases where the **pre** element could be used:

- Including an email, with paragraphs indicated by blank lines, lists indicated by lines prefixed with a bullet, and so on.

- Including fragments of computer code, with structure indicated according to the conventions of that language.
- Displaying ASCII art.

Authors are encouraged to consider how preformatted text will be experienced when the formatting is lost, as will be the case for users of speech synthesizers, braille displays, and the like. For cases like ASCII art, it is likely that an alternative presentation, such as a textual description, would be more universally accessible to the readers of the document.

To represent a block of computer code, the `pre` element can be used with a `code` element; to represent a block of computer output the `pre` element can be used with a `samp` element. Similarly, the `kbd` element can be used within a `pre` element to indicate text that the user is to enter.

This element [has rendering requirements involving the bidirectional algorithm](#).

In the following snippet, a sample of computer code is presented.

```
<p>This is the <code>Panel</code> constructor:</p>
<pre><code>function Panel(element, canClose, closeHandler) {
    this.element = element;
    this.canClose = canClose;
    this.closeHandler = function () { if (closeHandler) closeHandler(); };
}</code></pre>
```

In the following snippet, `samp` and `kbd` elements are mixed in the contents of a `pre` element to show a session of Zork I.

```
<pre><samp>You are in an open field west of a big white house with a boarded
front door.
There is a small mailbox here.

></samp> <kbd>open mailbox</kbd>

<samp>Opening the mailbox reveals:
A leaflet.

></samp></pre>
```

The following shows a contemporary poem that uses the `pre` element to preserve its unusual formatting, which forms an intrinsic part of the poem itself.

```
<pre>          maxling
it is with a      heart
                  heavy
```

that i admit loss of a feline
so loved

a friend lost to the
unknown

(night)

~cdr 11dec07</pre>

4.4.4 The **blockquote** element

✓MDN

[Element/blockquote](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

✓MDN

[HTMLQuoteElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 16+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content.](#)

[Sectioning root.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [flow content](#) is expected.

Content model:

[Flow content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

cite — Link to the source of the quotation or more information about the edit

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLQuoteElement : HTMLElement {
  [HTMLConstructor] constructor();
  [CEReactions] attribute USVString cite;
};
```

The **HTMLQuoteElement** interface is also used by the **q** element.

The **blockquote** element represents a section that is quoted from another source.

Content inside a **blockquote** must be quoted from another source, whose address, if it has one, may be cited in the **cite** attribute.

If the **cite** attribute is present, it must be a valid URL potentially surrounded by spaces. To obtain the corresponding citation link, the value of the attribute must be parsed relative to the element's node document. User agents may allow users to follow such citation links, but they are primarily intended for private use (e.g., by server-side scripts collecting statistics about a site's use of quotations), not for readers.

The content of a **blockquote** may be abbreviated or may have context added in the conventional manner for the text's language.

For example, in English this is traditionally done using square brackets. Consider a page with the sentence "Jane ate the cracker. She then said she liked apples and fish."; it could be quoted as follows:

```
<blockquote>
  <p>[Jane] then said she liked [...] fish.</p>
</blockquote>
```

Attribution for the quotation, if any, must be placed outside the **blockquote** element.

For example, here the attribution is given in a paragraph after the quote:

```
<blockquote>
  <p>I contend that we are both atheists. I just believe in one fewer
  god than you do. When you understand why you dismiss all the other
  possible gods, you will understand why I dismiss yours.</p>
</blockquote>
<p>-- Stephen Roberts</p>
```

The other examples below show other ways of showing attribution.

The `cite` IDL attribute must reflect the element's `cite` content attribute.

Here a `blockquote` element is used in conjunction with a `figure` element and its `figcaption` to clearly relate a quote to its attribution (which is not part of the quote and therefore doesn't belong inside the `blockquote` itself):

```
<figure>
<blockquote>


The truth may be puzzling. It may take some work to grapple with. It may be counterintuitive. It may contradict deeply held prejudices. It may not be consonant with what we desperately want to be true. But our preferences do not determine what's true. We have a method, and that method helps us to reach not absolute truth, only asymptotic approaches to the truth – never there, just closer and closer, always finding vast new oceans of undiscovered possibilities. Cleverly designed experiments are the key.


</blockquote>
<figcaption>Carl Sagan, in "<cite>Wonder and Skepticism</cite>", from the <cite>Skeptical Inquirer</cite> Volume 19, Issue 1 (January-February 1995)</figcaption>
</figure>
```

This next example shows the use of [cite](#) alongside [blockquote](#):

```
<p>His next piece was the aptly named <cite>Sonnet 130</cite>:</p>
<blockquote cite="https://quotes.example.org/s/sonnet130.html">
  <p>My mistress' eyes are nothing like the sun,<br>
  Coral is far more red, than her lips red,<br>
  ...

```

This example shows how a forum post could use `blockquote` to show what post a user is replying to. The `article` element is used for each post, to mark up the threading.

```
<article>
  <h1><a href="https://bacon.example.com/?blog=109431">Bacon on a crowbar</a></h1>
</article>
```

```

<header><strong>t3yw</strong> 12 points 1 hour ago</header>
<p>I bet a narwhal would love that.</p>
<footer><a href="?pid=29578">permalink</a></footer>
<article>
  <header><strong>greg</strong> 8 points 1 hour ago</header>
  <blockquote><p>I bet a narwhal would love that.</p></blockquote>
  <p>Dude narwhals don't eat bacon.</p>
  <footer><a href="?pid=29579">permalink</a></footer>
<article>
  <header><strong>t3yw</strong> 15 points 1 hour ago</header>
  <blockquote>
    <blockquote><p>I bet a narwhal would love that.</p></blockquote>
    <p>Dude narwhals don't eat bacon.</p>
  </blockquote>
  <p>Next thing you'll be saying they don't get capes and wizard
hats either!</p>
  <footer><a href="?pid=29580">permalink</a></footer>
<article>
  <article>
    <header><strong>boing</strong> -5 points 1 hour ago</header>
    <p>narwhals are worse than ceiling cat</p>
    <footer><a href="?pid=29581">permalink</a></footer>
  </article>
  </article>
</article>
<article>
  <header><strong>fred</strong> 1 points 23 minutes ago</header>
  <blockquote><p>I bet a narwhal would love that.</p></blockquote>
  <p>I bet they'd love to peel a banana too.</p>
  <footer><a href="?pid=29582">permalink</a></footer>
</article>
</article>
</article>

```

This example shows the use of a [blockquote](#) for short snippets, demonstrating that one does not have to use [p](#) elements inside [blockquote](#) elements:

```

<p>He began his list of "lessons" with the following:</p>
<blockquote>One should never assume that his side of
the issue will be recognized, let alone that it will
be conceded to have merits.</blockquote>
<p>He continued with a number of similar points, ending with:</p>
<blockquote>Finally, one should be prepared for the threat
of breakdown in negotiations at any given moment and not
be cowed by the possibility.</blockquote>
<p>We shall now discuss these points...

```

[Examples of how to represent a conversation](#) are shown in a later section; it is not appropriate to use the [**cite**](#) and [**blockquote**](#) elements for this purpose.

4.4.5 The **ol** element

✓MDN

[Element/ol](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLListElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content](#).

If the element's children include at least one [**li**](#) element: [Palpable content](#).

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected.

[Content model:](#)

Zero or more [**li**](#) and [script-supporting](#) elements.

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[**reversed**](#) — Number the list backwards

[**start**](#) — [Starting value](#) of the list

[**type**](#) — Kind of list marker

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLListElement : HTMLElement {
  HTMLConstructor constructor();

  CEReactions attribute boolean reversed;
  CEReactions attribute long start;
  CEReactions attribute DOMString type;

  // also has obsolete members
};
```

The [**ol**](#) element [represents](#) a list of items, where the items have been intentionally ordered, such that changing the order would change the meaning of the document.

The items of the list are the [**li**](#) element child nodes of the [**ol**](#) element, in [tree order](#).



[Element/ol#attr-reversed](#)

Support in all current engines.

Firefox 18+ Safari 6+ Chrome 18+

Opera Yes Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 18+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

The **reversed** attribute is a [boolean attribute](#). If present, it indicates that the list is a descending list (... , 3, 2, 1). If the attribute is omitted, the list is an ascending list (1, 2, 3, ...).

The **start** attribute, if present, must be a [valid integer](#). It is used to determine the [starting value](#) of the list.

An [**ol**](#) element has a *starting value*, which is an integer determined as follows:

1. If the `ol` element has a [start](#) attribute, then:
 1. Let `parsed` be the result of [parsing the value of the attribute as an integer](#).
 2. If `parsed` is not an error, then return `parsed`.
2. If the `ol` element has a [reversed](#) attribute, then return the number of [owned li elements](#).
3. Return 1.

The `type` attribute can be used to specify the kind of marker to use in the list, in the cases where that matters (e.g. because items are to be [referenced](#) by their number/letter). The attribute, if specified, must have a value that is [identical to](#) one of the characters given in the first cell of one of the rows of the following table. The `type` attribute represents the state given in the cell in the second column of the row whose first cell matches the attribute's value; if none of the cells match, or if the attribute is omitted, then the attribute represents the [decimal](#) state.

Keyword	State	Description	Examples for values 1-3 and 3999-4001	
<code>1</code> (U+0031)	<code>decimal</code>	Decimal numbers	1.	2. 3. ... 3999. 4000. 4001. ...
<code>a</code> (U+0061)	<code>lower-alpha</code>	Lowercase latin alphabet	a. b. c. ... ewu.	ewv. eww. ...
<code>A</code> (U+0041)	<code>upper-alpha</code>	Uppercase latin alphabet	A. B. C. ... EWU.	EWV. EWW. ...
<code>i</code> (U+0069)	<code>lower-roman</code>	Lowercase roman numerals	i. ii. iii. ... mmmcmxcix.	iv. vi. ...
<code>I</code> (U+0049)	<code>upper-roman</code>	Uppercase roman numerals	I. II. III. ... MMMCMXCIX.	IV. VI. ...

User agents should render the items of the list in a manner consistent with the state of the `type` attribute of the `ol` element. Numbers less than or equal to zero should always use the decimal system regardless of the `type` attribute.

For CSS user agents, a mapping for this attribute to the ['list-style-type'](#) CSS property is given [in the Rendering section](#) (the mapping is straightforward: the states above have the same names as their corresponding CSS values).

It is possible to redefine the default CSS list styles used to implement this attribute in CSS user agents; doing so will affect how list items are rendered.

The `reversed` and `type` IDL attributes must [reflect](#) the respective content attributes of the same name.

The `start` IDL attribute must [reflect](#) the content attribute of the same name, with a default value of 1.

This means that the [start](#) IDL attribute does not necessarily match the list's [starting value](#), in cases where the [start](#) content attribute is omitted and the [reversed](#) content attribute is specified.

The following markup shows a list where the order matters, and where the [ol](#) element is therefore appropriate. Compare this list to the equivalent list in the [ul](#) section to see an example of the same items using the [ul](#) element.

```
<p>I have lived in the following countries (given in the order of when I first lived there):</p>
<ol>
  <li>Switzerland
  <li>United Kingdom
  <li>United States
  <li>Norway
</ol>
```

Note how changing the order of the list changes the meaning of the document. In the following example, changing the relative order of the first two items has changed the birthplace of the author:

```
<p>I have lived in the following countries (given in the order of when I first lived there):</p>
<ol>
  <li>United Kingdom
  <li>Switzerland
  <li>United States
  <li>Norway
</ol>
```

4.4.6 The **ul** element

✓MDN

[Element/ul](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLULElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content](#).

If the element's children include at least one [li](#) element: [Palpable content](#).

Contexts in which this element can be used:

Where [flow content](#) is expected.

Content model:

Zero or more [li](#) and [script-supporting](#) elements.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLUListElement : HTMLElement {
  [HTMLConstructor] constructor();
  // also has obsolete members
};
```

The [ul](#) element [represents](#) a list of items, where the order of the items is not important — that is, where changing the order would not materially change the meaning of the document.

The items of the list are the [li](#) element child nodes of the [ul](#) element.

The following markup shows a list where the order does not matter, and where the [ul](#) element is therefore appropriate. Compare this list to the equivalent list in the [ol](#) section to see an example of the same items using the [ol](#) element.

<p>I have lived in the following countries:</p>

```
<ul>
  <li>Norway
  <li>Switzerland
  <li>United Kingdom
  <li>United States
</ul>
```

Note that changing the order of the list does not change the meaning of the document. The items in the snippet above are given in alphabetical order, but in the snippet below they are given in order of the size of their current account balance in 2007, without changing the meaning of the document whatsoever:

```
<p>I have lived in the following countries:</p>
<ul>
  <li>Switzerland
  <li>Norway
  <li>United Kingdom
  <li>United States
</ul>
```

4.4.7 The **menu** element



[Element/menu](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+



[HTMLMenuElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content](#).

If the element's children include at least one [li](#) element: [Palpable content](#).

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected.

[Content model:](#)

Zero or more [li](#) and [script-supporting](#) elements.

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLMenuElement : HTMLElement {
  [HTMLConstructor] constructor();
  // also has obsolete members
};
```

The [menu](#) element [represents](#) a toolbar consisting of its contents, in the form of an unordered list of items (represented by [li](#) elements), each of which represents a command that the user can perform or activate.

The [menu](#) element is simply a semantic alternative to [ul](#) to express an unordered list of commands (a "toolbar").

In this example, a text-editing application uses a [menu](#) element to provide a series of editing commands:

```
<menu>
  <li><button onclick="copy()"></button></li>
  <li><button onclick="cut()"></button></li>
  <li><button onclick="paste()"></button></li>
</menu>
```

Note that the styling to make this look like a conventional toolbar menu is up to the application.

4.4.8 The ***li*** element

✓MDN

Element/li

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

✓MDN

HTML Element

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

None.

Contexts in which this element can be used:

Inside **ol** elements.

Inside **ul** elements.

Inside **menu** elements.

Content model:

Flow content.

Tag omission in text/html:

An **li** element's end tag can be omitted if the **li** element is immediately followed by another **li** element or if there is no more content in the parent element.

Content attributes:

Global attributes

If the element is not a child of an **ul** or **menu** element: **value** — Ordinal value of the list item

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLLIElement : HTMLElement {
    [HTMLConstructor] constructor();

    [CEReactions] attribute long value;

    // also has obsolete members
};
```

The [li](#) element [represents](#) a list item. If its parent element is an [ol](#), [ul](#), or [menu](#) element, then the element is an item of the parent element's list, as defined for those elements. Otherwise, the list item has no defined list-related relationship to any other [li](#) element.

The [value](#) attribute, if present, must be a [valid integer](#). It is used to determine the [ordinal value](#) of the list item, when the [li](#)'s [list owner](#) is an [ol](#) element.

Any element whose [computed value](#) of '[display](#)' is 'list-item' has a *list owner*, which is determined as follows:

1. If the element is not [being rendered](#), return null; the element has no [list owner](#).
2. Let *ancestor* be the element's parent.
3. If the element has an [ol](#), [ul](#), or [menu](#) ancestor, set *ancestor* to the closest such ancestor element.
4. Return the closest inclusive ancestor of *ancestor* that produces a [CSS box](#).

Such an element will always exist, as at the very least the [document element](#) will always produce a [CSS box](#).

To determine the *ordinal value* of each element owned by a given [list owner](#) owner, perform the following steps:

1. Let *i* be 1.
2. If *owner* is an [ol](#) element, let *numbering* be *owner*'s [starting value](#). Otherwise, let *numbering* be 1.
3. *Loop*: If *i* is greater than the number of [list items that owner owns](#), then return; all of

owner's [owned list items](#) have been assigned [ordinal values](#).

4. Let *item* be the *i*th of *owner*'s [owned list items](#), in [tree order](#).
 5. If *item* is an [li](#) element that has a [value](#) attribute, then:
 1. Let *parsed* be the result of [parsing the value of the attribute as an integer](#).
 2. If *parsed* is not an error, then set *numbering* to *parsed*.
 6. The [ordinal value](#) of *item* is *numbering*.
 7. If *owner* is an [ol](#) element, and *owner* has a [reversed](#) attribute, decrement *numbering* by 1; otherwise, increment *numbering* by 1.
 8. Increment *i* by 1.
 9. Go to the step labeled *loop*.
-

The [value](#) IDL attribute must [reflect](#) the value of the [value](#) content attribute.

The element's [value](#) IDL attribute does not directly correspond to its [ordinal value](#); it simply [reflects](#) the content attribute. For example, given this list:

```
<ol>
  <li>Item 1
  <li value="3">Item 3
  <li>Item 4
</ol>
```

The [ordinal values](#) are 1, 3, and 4, whereas the [value](#) IDL attributes return 0, 3, 0 on getting.

The following example, the top ten movies are listed (in reverse order). Note the way the list is given a title by using a [figure](#) element and its [figcaption](#) element.

```
<figure>
  <figcaption>The top 10 movies of all time</figcaption>
  <ol>
    <li value="10"><cite>Josie and the Pussycats</cite>, 2001</li>
    <li value="9"><cite lang="sh">Црна мачка, бели мачор</cite>, 1998</li>
    <li value="8"><cite>A Bug's Life</cite>, 1998</li>
    <li value="7"><cite>Toy Story</cite>, 1995</li>
    <li value="6"><cite>Monsters, Inc</cite>, 2001</li>
    <li value="5"><cite>Cars</cite>, 2006</li>
    <li value="4"><cite>Toy Story 2</cite>, 1999</li>
    <li value="3"><cite>Finding Nemo</cite>, 2003</li>
    <li value="2"><cite>The Incredibles</cite>, 2004</li>
```

```
<li value="1"><cite>Ratatouille</cite>, 2007</li>
</ol>
</figure>
```

The markup could also be written as follows, using the [reversed](#) attribute on the [ol](#) element:

```
<figure>
  <figcaption>The top 10 movies of all time</figcaption>
  <ol reversed>
    <li><cite>Josie and the Pussycats</cite>, 2001</li>
    <li><cite lang="sh">Црна мачка, бели мачор</cite>, 1998</li>
    <li><cite>A Bug's Life</cite>, 1998</li>
    <li><cite>Toy Story</cite>, 1995</li>
    <li><cite>Monsters, Inc</cite>, 2001</li>
    <li><cite>Cars</cite>, 2006</li>
    <li><cite>Toy Story 2</cite>, 1999</li>
    <li><cite>Finding Nemo</cite>, 2003</li>
    <li><cite>The Incredibles</cite>, 2004</li>
    <li><cite>Ratatouille</cite>, 2007</li>
  </ol>
</figure>
```

While it is conforming to include heading elements (e.g. [h1](#)) inside [li](#) elements, it likely does not convey the semantics that the author intended. A heading starts a new section, so a heading in a list implicitly splits the list into spanning multiple sections.

4.4.9 The **dl** element



[Element/dl](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes



[HTMLDListElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Categories:

[Flow content.](#)

If the element's children include at least one name-value group: [Palpable content](#).

Contexts in which this element can be used:

Where [flow content](#) is expected.

Content model:

Either: Zero or more groups each consisting of one or more [dt](#) elements followed by one or more [dd](#) elements, optionally intermixed with [script-supporting elements](#).

Or: One or more [div](#) elements, optionally intermixed with [script-supporting elements](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLListElement : HTMLElement {
  [HTMLConstructor] constructor();
  // also has obsolete members
};
```

The [dl](#) element [represents](#) an association list consisting of zero or more name-value groups (a description list). A name-value group consists of one or more names ([dt](#) elements, possibly as children of a [div](#) element child) followed by one or more values ([dd](#) elements, possibly as children of a [div](#) element child), ignoring any nodes other than [dt](#) and [dd](#) element children, and [dt](#) and [dd](#) elements that are children of [div](#) element children. Within a single [dl](#) element, there should not be more than one [dt](#) element for each name.

Name-value groups may be terms and definitions, metadata topics and values, questions and answers, or any other groups of name-value data.

The values within a group are alternatives; multiple paragraphs forming part of the same value must all be given within the same `dd` element.

The order of the list of groups, and of the names and values within each group, may be significant.

In order to annotate groups with [microdata](#) attributes, or other [global attributes](#) that apply to whole groups, or just for styling purposes, each group in a `dl` element can be wrapped in a `div` element. This does not change the semantics of the `dl` element.

The name-value groups of a `dl` element *dl* are determined using the following algorithm. A name-value group has a name (a list of `dt` elements, initially empty) and a value (a list of `dd` elements, initially empty).

1. Let *groups* be an empty list of name-value groups.
2. Let *current* be a new name-value group.
3. Let *seenDd* be false.
4. Let *child* be *dl*'s [first child](#).
5. Let *grandchild* be null.
6. While *child* is not null:
 1. If *child* is a `div` element, then:
 1. Let *grandchild* be *child*'s [first child](#).
 2. While *grandchild* is not null:
 1. [Process dt or dd](#) for *grandchild*.
 2. Set *grandchild* to *grandchild*'s [next sibling](#).
 2. Otherwise, [process dt or dd](#) for *child*.
 3. Set *child* to *child*'s [next sibling](#).
 7. If *current* is not empty, then append *current* to *groups*.
 8. Return *groups*.

To [process dt or dd](#) for a node *node* means to follow these steps:

1. Let *groups*, *current*, and *seenDd* be the same variables as those of the same name in the algorithm that invoked these steps.

2. If *node* is a **[dt](#)** element, then:
 1. If *seenDd* is true, then append *current* to *groups*, set *current* to a new name-value group, and set *seenDd* to false.
 2. Append *node* to *current*'s name.
3. Otherwise, if *node* is a **[dd](#)** element, then append *node* to *current*'s value and set *seenDd* to true.

When a name-value group has an empty list as name or value, it is often due to accidentally using **[dd](#)** elements in the place of **[dt](#)** elements and vice versa. Conformance checkers can spot such mistakes and might be able to advise authors how to correctly use the markup.

In the following example, one entry ("Authors") is linked to two values ("John" and "Luke").

```
<dl>
  <dt> Authors
  <dd> John
  <dd> Luke
  <dt> Editor
  <dd> Frank
</dl>
```

In the following example, one definition is linked to two terms.

```
<dl>
  <dt lang="en-US"> <dfn>color</dfn> </dt>
  <dt lang="en-GB"> <dfn>colour</dfn> </dt>
  <dd> A sensation which (in humans) derives from the ability of
       the fine structure of the eye to distinguish three differently
       filtered analyses of a view. </dd>
</dl>
```

The following example illustrates the use of the **[dl](#)** element to mark up metadata of sorts. At the end of the example, one group has two metadata labels ("Authors" and "Editors") and two values ("Robert Rothman" and "Daniel Jackson"). This example also uses the **[div](#)** element around the groups of **[dt](#)** and **[dd](#)** element, to aid with styling.

```
<dl>
  <div>
    <dt> Last modified time </dt>
    <dd> 2004-12-23T23:33Z </dd>
  </div>
  <div>
    <dt> Recommended update interval </dt>
    <dd> 60s </dd>
```

```

</div>
<div>
  <dt> Authors </dt>
  <dt> Editors </dt>
  <dd> Robert Rothman </dd>
  <dd> Daniel Jackson </dd>
</div>
</dl>

```

The following example shows the [dl](#) element used to give a set of instructions. The order of the instructions here is important (in the other examples, the order of the blocks was not important).

```

<p>Determine the victory points as follows (use the
first matching case):</p>
<dl>
  <dt> If you have exactly five gold coins </dt>
  <dd> You get five victory points </dd>
  <dt> If you have one or more gold coins, and you have one or more silver coins
  <dd> You get two victory points </dd>
  <dt> If you have one or more silver coins </dt>
  <dd> You get one victory point </dd>
  <dt> Otherwise </dt>
  <dd> You get no victory points </dd>
</dl>

```

The following snippet shows a [dl](#) element being used as a glossary. Note the use of [dfn](#) to indicate the word being defined.

```

<dl>
  <dt><dfn>Apartment</dfn>, n.</dt>
  <dd>An execution context grouping one or more threads with one or
more COM objects.</dd>
  <dt><dfn>Flat</dfn>, n.</dt>
  <dd>A deflated tire.</dd>
  <dt><dfn>Home</dfn>, n.</dt>
  <dd>The user's login directory.</dd>
</dl>

```

This example uses [microdata](#) attributes in a [dl](#) element, together with the [div](#) element, to annotate the ice cream desserts at a French restaurant.

```

<dl>
  <div itemscope itemtype="http://schema.org/Product">
    <dt itemprop="name">Café ou Chocolat Liégeois
    <dd itemprop="offers" itemscope itemtype="http://schema.org/Offer">
      <span itemprop="price">3.50</span>

```

```

<data itemprop="priceCurrency" value="EUR">€</data>
<dd itemprop="description">
  2 boules Café ou Chocolat, 1 boule Vanille, sauce café ou chocolat, chantilly
</div>

<div itemscope itemtype="http://schema.org/Product">
  <dt itemprop="name">Américaine
  <dd itemprop="offers" itemscope itemtype="http://schema.org/Offer">
    <span itemprop="price">3.50</span>
    <data itemprop="priceCurrency" value="EUR">€</data>
    <dd itemprop="description">
      1 boule Crème brûlée, 1 boule Vanille, 1 boule Caramel, chantilly
  </div>
</dl>

```

Without the `div` element the markup would need to use the `itemref` attribute to link the data in the `dd` elements with the item, as follows.

```

<dl>
  <dt itemscope itemtype="http://schema.org/Product" itemref="1-offer 1-description">
    <span itemprop="name">Café ou Chocolat Liégeois</span>
  <dd id="1-offer" itemprop="offers" itemscope itemtype="http://schema.org/Offer">
    <span itemprop="price">3.50</span>
    <data itemprop="priceCurrency" value="EUR">€</data>
  <dd id="1-description" itemprop="description">
    2 boules Café ou Chocolat, 1 boule Vanille, sauce café ou chocolat, chantilly

  <dt itemscope itemtype="http://schema.org/Product" itemref="2-offer 2-description">
    <span itemprop="name">Américaine</span>
  <dd id="2-offer" itemprop="offers" itemscope itemtype="http://schema.org/Offer">
    <span itemprop="price">3.50</span>
    <data itemprop="priceCurrency" value="EUR">€</data>
  <dd id="2-description" itemprop="description">
    1 boule Crème brûlée, 1 boule Vanille, 1 boule Caramel, chantilly
</dl>

```

The `dl` element is inappropriate for marking up dialogue. See some [examples of how to mark up dialogue](#).

4.4.10 The `dt` element



[Element/dt](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) No Internet Explorer Yes

Firefox Yes Android 4+ Safari iOS Yes Chrome Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

None.

Contexts in which this element can be used:

Before [dd](#) or [dt](#) elements inside [dl](#) elements.

Before [dd](#) or [dt](#) elements inside [div](#) elements that are children of a [dl](#) element.

Content model:

[Flow content](#), but with no [header](#), [footer](#), [sectioning content](#), or [heading content](#) descendants.

Tag omission in text/html:

A [dt](#) element's [end tag](#) can be omitted if the [dt](#) element is immediately followed by another [dt](#) element or a [dd](#) element.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

Uses [HTMLElement](#).

The [dt](#) element [represents](#) the term, or name, part of a term-description group in a description list ([dl](#) element).

The [dt](#) element itself, when used in a [dl](#) element, does not indicate that its contents are a term being defined, but this can be indicated using the [dfn](#) element.

This example shows a list of frequently asked questions (a FAQ) marked up using the [dt](#) element for questions and the [dd](#) element for answers.

```
<article>
  <h1>FAQ</h1>
  <dl>
    <dt>What do we want?</dt>
    <dd>Our data.</dd>
    <dt>When do we want it?</dt>
    <dd>Now.</dd>
```

```
<dt>Where is it?</dt>
<dd>We are not sure.</dd>
</dl>
</article>
```

4.4.11 The **dd** element



[Element/dd](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

After [dt](#) or [dd](#) elements inside [dl](#) elements.

After [dt](#) or [dd](#) elements inside [div](#) elements that are children of a [dl](#) element.

[Content model:](#)

[Flow content.](#)

[Tag omission in text/html:](#)

A [dd](#) element's [end tag](#) can be omitted if the [dd](#) element is immediately followed by another [dd](#) element or a [dt](#) element, or if there is no more content in the parent element.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [dd](#) element [represents](#) the description, definition, or value, part of a term-description group in a description list ([dl](#) element).

A [dl](#) can be used to define a vocabulary list, like in a dictionary. In the following example, each entry, given by a [dt](#) with a [dfn](#), has several [dd](#)s, showing the various parts of the definition.

```
<dl>
  <dt><dfn>happiness</dfn></dt>
  <dd class="pronunciation">/'hæpinəs/</dd>
  <dd class="part-of-speech"><i><abbr>n.</abbr></i></dd>
  <dd>The state of being happy.</dd>
  <dd>Good fortune; success. <q>Oh <b>happiness</b>! It worked!</q></dd>
  <dt><dfn>rejoice</dfn></dt>
  <dd class="pronunciation">/rɪ'dʒɔɪs/</dd>
  <dd><i class="part-of-speech"><abbr>v.intr.</abbr></i> To be delighted oneself
  <dd><i class="part-of-speech"><abbr>v.tr.</abbr></i> To cause one to be delighted
</dl>
```

4.4.12 The **figure** element



[Element/figure](#)

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 8+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 5+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11+

[Categories:](#)

[Flow content](#).

[Sectioning root](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected.

[Content model:](#)

Either: one [figcaption](#) element followed by [flow content](#).

Or: [flow content](#) followed by one [figcaption](#) element.

Or: [flow content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTMLElement](#).

The [figure](#) element [represents](#) some [flow content](#), optionally with a caption, that is self-contained (like a complete sentence) and is typically [referenced](#) as a single unit from the main flow of the document.

"Self-contained" in this context does not necessarily mean independent. For example, each sentence in a paragraph is self-contained; an image that is part of a sentence would be inappropriate for [figure](#), but an entire sentence made of images would be fitting.

The element can thus be used to annotate illustrations, diagrams, photos, code listings, etc.

When a [figure](#) is referred to from the main content of the document by identifying it by its caption (e.g., by figure number), it enables such content to be easily moved away from that primary content, e.g., to the side of the page, to dedicated pages, or to an appendix, without affecting the flow of the document.

If a [figure](#) element is [referenced](#) by its relative position, e.g., "in the photograph above" or "as the next figure shows", then moving the figure would disrupt the page's meaning. Authors are encouraged to consider using labels to refer to figures, rather than using such relative references, so that the page can easily be restyled without affecting the page's meaning.

The first [figcaption](#) element child of the element, if any, represents the caption of the [figure](#) element's contents. If there is no child [figcaption](#) element, then there is no caption.

A [figure](#) element's contents are part of the surrounding flow. If the purpose of the page is to display the figure, for example a photograph on an image sharing site, the [figure](#) and [figcaption](#) elements can be used to explicitly provide a caption for that figure. For content that is only tangentially related, or that serves a separate purpose than the surrounding flow, the [aside](#) element should be used (and can itself wrap a [figure](#)). For example, a pull quote that repeats content from an [article](#) would be more appropriate in an [aside](#) than in a [figure](#), because it isn't part of the content, it's a repetition of the content for the purposes of enticing readers or highlighting key topics.

This example shows the [figure](#) element to mark up a code listing.

```
<p>In <a href="#l4">listing 4</a> we see the primary core interface API declaration.</p>
```

```

<figure id="l4">
  <figcaption>Listing 4. The primary core interface API declaration.</figcaption>
  <pre><code>interface PrimaryCore {
    boolean verifyDataLine();
    undefined sendData(sequence<byte> data);
    undefined initSelfDestruct();
}</code></pre>
</figure>
<p>The API is designed to use UTF-8.</p>

```

Here we see a [figure](#) element to mark up a photo that is the main content of the page (as in a gallery).

```

<!DOCTYPE HTML>
<html lang="en">
<title>Bubbles at work – My Gallery™</title>
<figure>
  
  <figcaption>Bubbles at work</figcaption>
</figure>
<nav><a href="19414.html">Prev</a> – <a href="19416.html">Next</a></nav>

```

In this example, we see an image that is *not* a figure, as well as an image and a video that are. The first image is literally part of the example's second sentence, so it's not a self-contained unit, and thus [figure](#) would be inappropriate.

<h2>Malinko's comics</h2>

<p>This case centered on some sort of "intellectual property" infringement related to a comic (see Exhibit A). The suit started after a trailer ending with these words:

```

<blockquote>
  
</blockquote>

```

<p>...was aired. A lawyer, armed with a Bigger Notebook, launched a preemptive strike using snowballs. A complete copy of the trailer is included with Exhibit B.

```

<figure>
  
  <figcaption>Exhibit A. The alleged <code>rough copy</code> comic.</figcaption>
</figure>

```

```
<figure>
  <video src="ex-b.mov"></video>
  <figcaption>Exhibit B. The <cite>Rough Copy</cite> trailer.</figcaption>
</figure>
```

<p>The case was resolved out of court.

Here, a part of a poem is marked up using [figure](#).

```
<figure>
  <p>'Twas brillig, and the slithy toves<br>
  Did gyre and gimble in the wabe;<br>
  All mimsy were the borogoves,<br>
  And the mome raths outgrabe.</p>
  <figcaption><cite>Jabberwocky</cite> (first verse). Lewis Carroll, 1832-98</figcaption>
</figure>
```

In this example, which could be part of a much larger work discussing a castle, nested [figure](#) elements are used to provide both a group caption and individual captions for each figure in the group:

```
<figure>
  <figcaption>The castle through the ages: 1423, 1858, and 1999 respectively.</figcaption>
  <figure>
    <figcaption>Etching. Anonymous, ca. 1423.</figcaption>
    
  </figure>
  <figure>
    <figcaption>Oil-based paint on canvas. Maria Towle, 1858.</figcaption>
    
  </figure>
  <figure>
    <figcaption>Film photograph. Peter Jankle, 1999.</figcaption>
    
  </figure>
</figure>
```

The previous example could also be more succinctly written as follows (using [title](#) attributes in place of the nested [figure/figcaption](#) pairs):

```
<figure>
  
  
  
</figure>
```

```
<figcaption>The castle through the ages: 1423, 1858, and 1999 respectively.</figure>
```

The figure is sometimes [referenced](#) only implicitly from the content:

```
<article>
  <h1>Fiscal negotiations stumble in Congress as deadline nears</h1>
  <figure>
    
    <figcaption>Barack Obama and Harry Reid. White House press photograph.</figcaption>
  </figure>
  <p>Negotiations in Congress to end the fiscal impasse sputtered on Tuesday, October 1, grasping for a way to reopen the government and raise the country's borrowing limit before a Thursday deadline drawing near.</p>
  ...
</article>
```

4.4.13 The ***figcaption*** element



[Element/figcaption](#)

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 8+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 5+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As the first or last child of a [figure](#) element.

[Content model:](#)

[Flow content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [figcaption](#) element [represents](#) a caption or legend for the rest of the contents of the [figcaption](#) element's parent [figure](#) element, if any.

The element can contain additional information about the source:

```
<figcaption>
  <p>A duck.</p>
  <p><small>Photograph courtesy of ☆ News.</small></p>
</figcaption>

<figcaption>
  <p>Average rent for 3-room apartments, excluding non-profit apartments</p>
  <p>Zürich's Statistics Office – <time datetime=2017-11-14>14 November 2017</p>
</figcaption>
```

4.4.14 The **main** element



[Element/main](#)

Support in all current engines.

Firefox 21+ Safari 7+ Chrome 26+

Opera 16+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 21+ Safari iOS 7+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Categories:](#)

[Flow content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected, but only if it is a [hierarchically correct main element](#).

[Content model:](#)

[Flow content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [main](#) element [represents](#) the dominant contents of the document.

A document must not have more than one [main](#) element that does not have the [hidden](#) attribute specified.

A *hierarchically correct main element* is one whose ancestor elements are limited to [html](#), [body](#), [div](#), [form](#) without an [accessible name](#), and [autonomous custom elements](#). Each [main](#) element must be a [hierarchically correct main element](#).

In this example, the author has used a presentation where each component of the page is rendered in a box. To wrap the main content of the page (as opposed to the header, the footer, the navigation bar, and a sidebar), the [main](#) element is used.

```
<!DOCTYPE html>
<html lang="en">
<title>RPG System 17</title>
<style>
  header, nav, aside, main, footer {
    margin: 0.5em; border: thin solid; padding: 0.5em;
    background: #EFF; color: black; box-shadow: 0 0 0.25em #033;
  }
  h1, h2, p { margin: 0; }
  nav, main { float: left; }
  aside { float: right; }
  footer { clear: both; }
</style>
<header>
  <h1>System Eighteen</h1>
</header>
<nav>
  <a href="../16/">← System 17</a>
  <a href="../18/">RPXIX →</a>
</nav>
<aside>
  <p>This system has no HP mechanic, so there's no healing.</p>
</aside>
<main>
```

```
<h2>Character creation</h2>
<p>Attributes (magic, strength, agility) are purchased at the cost of one point each.
<h2>Rolls</h2>
<p>Each encounter, roll the dice for all your skills. If you roll more than ...
</main>
<footer>
  <p>Copyright © 2013
</footer>
</html>
```

In the following example, multiple `main` elements are used and script is used to make navigation work without a server roundtrip and to set the `hidden` attribute on those that are not current:

```
<!doctype html>
<html lang=en-CA>
<meta charset=utf-8>
<title> ... </title>
<link rel=stylesheet href=spa.css>
<script src=spa.js async></script>
<nav>
  <a href=/>Home</a>
  <a href=/about>About</a>
  <a href=/contact>Contact</a>
</nav>
<main>
  <h1>Home</h1>
  ...
</main>
<main hidden>
  <h1>About</h1>
  ...
</main>
<main hidden>
  <h1>Contact</h1>
  ...
</main>
<footer>Made with ❤ by <a href=https://example.com/>Example 🌐</a>.</footer>
```

4.4.15 The **div** element



[Element/div](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLDivElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [flow content](#) is expected.

As a child of a [dl](#) element.

Content model:

If the element is a child of a [dl](#) element: one or more [dt](#) elements followed by one or more [dd](#) elements, optionally intermixed with [script-supporting elements](#).

If the element is not a child of a [dl](#) element: [flow content](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

[Exposed=Window]

```
interface HTMLDivElement : HTMLElement {
```

```
[HTMLConstructor] constructor();  
// also has obsolete members  
};
```

The `div` element has no special meaning at all. It represents its children. It can be used with the `class`, `lang`, and `title` attributes to mark up semantics common to a group of consecutive elements. It can also be used in a `dl` element, wrapping groups of `dt` and `dd` elements.

Authors are strongly encouraged to view the `div` element as an element of last resort, for when no other element is suitable. Use of more appropriate elements instead of the `div` element leads to better accessibility for readers and easier maintainability for authors.

For example, a blog post would be marked up using `article`, a chapter using `section`, a page's navigation aids using `nav`, and a group of form controls using `fieldset`.

On the other hand, `div` elements can be useful for stylistic purposes or to wrap multiple paragraphs within a section that are all to be annotated in a similar way. In the following example, we see `div` elements used as a way to set the language of two paragraphs at once, instead of setting the language on the two paragraph elements separately:

```
<article lang="en-US">  
  <h1>My use of language and my cats</h1>  
  <p>My cat's behavior hasn't changed much since her absence, except  
    that she plays her new physique to the neighbors regularly, in an  
    attempt to get pets.</p>  
  <div lang="en-GB">  
    <p>My other cat, coloured black and white, is a sweetie. He followed  
      us to the pool today, walking down the pavement with us. Yesterday  
      he apparently visited our neighbours. I wonder if he recognises that  
      their flat is a mirror image of ours.</p>  
    <p>Hm, I just noticed that in the last paragraph I used British  
      English. But I'm supposed to write in American English. So I  
      shouldn't say "pavement" or "flat" or "colour"...</p>  
  </div>  
  <p>I should say "sidewalk" and "apartment" and "color"!</p>  
</article>
```

4.5 Text-level semantics

4.5.1 The `a` element



Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

✓MDN

[HTMLAnchorElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content](#).

[Phrasing content](#).

If the element has an [href](#) attribute: [Interactive content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Transparent](#), but there must be no [interactive content](#) descendant, [a](#) element descendant, or descendant with the [tabindex](#) attribute specified.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[href](#) — Address of the [hyperlink](#)

[target](#) — [Browsing context](#) for [hyperlink navigation](#)

[download](#) — Whether to download the resource instead of navigating to it, and its filename if so

[ping](#) — [URLs](#) to ping

[rel](#) — Relationship between the location in the document containing the [hyperlink](#) and the destination resource

[hreflang](#) — Language of the linked resource

[type](#) — Hint for the type of the referenced resource

[referrerpolicy](#) — [Referrer policy](#) for [fetches](#) initiated by the element

[Accessibility considerations:](#)

If the element has an [href](#) attribute: [for authors](#); [for implementers](#).

Otherwise: [for authors](#); [for implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLAnchorElement : HTMLElement {
    [HTMLConstructor] constructor();

    [CEReactions] attribute DOMString target;
    [CEReactions] attribute DOMString download;
    [CEReactions] attribute USVString ping;
    [CEReactions] attribute DOMString rel;
    [SameObject, PutForwards=value] readonly attribute DOMTokenList relList;
    [CEReactions] attribute DOMString hreflang;
    [CEReactions] attribute DOMString type;

    [CEReactions] attribute DOMString text;

    [CEReactions] attribute DOMString referrerPolicy;

    // also has obsolete members
};

HTMLAnchorElement includes HTMLHyperlinkElementUtils;
```

If the [a](#) element has an [href](#) attribute, then it [represents](#) a [hyperlink](#) (a hypertext anchor) labeled by its contents.

If the [a](#) element has no [href](#) attribute, then the element [represents](#) a placeholder for where a link might otherwise have been placed, if it had been relevant, consisting of just the element's contents.

The [target](#), [download](#), [ping](#), [rel](#), [hreflang](#), [type](#), and [referrerpolicy](#) attributes must be omitted if the [href](#) attribute is not present.

If the [itemprop](#) attribute is specified on an [a](#) element, then the [href](#) attribute must also be specified.

If a site uses a consistent navigation toolbar on every page, then the link that would normally link to the page itself could be marked up using an element:

```
<nav>
  <ul>
    <li> <a href="/">Home</a> </li>
    <li> <a href="/news">News</a> </li>
    <li> <a>Examples</a> </li>
    <li> <a href="/legal">Legal</a> </li>
  </ul>
</nav>
```

The [href](#), [target](#), [download](#), [ping](#), and [referrerpolicy](#) attributes affect what happens when users [follow hyperlinks](#) or [download hyperlinks](#) created using the element. The [rel](#), [hreflang](#), and [type](#) attributes may be used to indicate to the user the likely nature of the target resource before the user follows the link.

The [activation behavior](#) of an element *element* given an event *event* is:

1. If *element* has no [href](#) attribute, then return.
2. Let *hyperlinkSuffix* be null.
3. If *event*'s [target](#) is an [img](#) with an [ismap](#) attribute specified, then:
 1. Let *x* and *y* be 0.
 2. If *event*'s [isTrusted](#) attribute is initialized to true, then set *x* to the distance in [CSS pixels](#) from the left edge of the image to the location of the click, and set *y* to the distance in [CSS pixels](#) from the top edge of the image to the location of the click.
 3. If *x* is negative, set *x* to 0.
 4. If *y* is negative, set *y* to 0.
 5. Set *hyperlinkSuffix* to the concatenation of U+003F (?), the value of *x* expressed as a base-ten integer using [ASCII digits](#), U+002C (,), and the value of *y* expressed as a base-ten integer using [ASCII digits](#).
4. If *element* has a [download](#) attribute, or if the user has expressed a preference to download the hyperlink, then [download the hyperlink](#) created by *element* given *hyperlinkSuffix*.
5. Otherwise, [follow the hyperlink](#) created by *element* given *hyperlinkSuffix*.

a .text

Same as [textContent](#).



[HTMLAnchorElement/download](#)

Support in all current engines.

Firefox 20+ Safari 10.1+ Chrome 15+

Opera 15+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 20+ Safari iOS 10.3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 14+

[HTMLAnchorElement/rel](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The IDL attributes *download*, *ping*, *target*, *rel*, *hreflang*, and *type*, must [reflect](#) the respective content attributes of the same name.



[HTMLAnchorElement/relList](#)

Support in all current engines.

Firefox 30+ Safari 9+ Chrome 65+

Opera 52+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 30+ Safari iOS 9+ Chrome Android 65+ WebView Android 65+ Samsung Internet 9.0+ Opera Android 47+

The IDL attribute *relList* must [reflect](#) the [rel](#) content attribute.



[HTMLAnchorElement/referrerPolicy](#)

Support in all current engines.

Firefox 50+ Safari 14+ Chrome 53+

Opera 40+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 50+ Safari iOS 14+ Chrome Android 53+ WebView Android 53+ Samsung Internet 7.2+ Opera Android 41+

The IDL attribute *referrerPolicy* must [reflect](#) the [referrerpolicy](#) content attribute, [limited to only known values](#).

The *text* attribute's getter must return this element's [descendant text content](#).

The *text* attribute's setter must [string replace all](#) with the given value within this element.

The [a](#) element can be wrapped around entire paragraphs, lists, tables, and so forth, even entire sections, so long as there is no interactive content within (e.g., buttons or other links). This example shows how this can be used to make an entire advertising block into a link:

```
<aside class="advertising">
  <h1>Advertising</h1>
  <a href="https://ad.example.com/?adid=1929&pubid=1422">
    <section>
      <h1>Mellblomatic 9000!</h1>
      <p>Turn all your widgets into mellbloms!</p>
      <p>Only $9.99 plus shipping and handling.</p>
    </section>
  </a>
  <a href="https://ad.example.com/?adid=375&pubid=1422">
    <section>
      <h1>The Mellblom Browser</h1>
      <p>Web browsing at the speed of light.</p>
      <p>No other browser goes faster!</p>
    </section>
  </a>
</aside>
```

The following example shows how a bit of script can be used to effectively make an entire row in a job listing table a hyperlink:

```
<table>
  <tr>
    <th>Position
    <th>Team
    <th>Location
```

```

<tr>
  <td><a href="/jobs/manager">Manager</a>
  <td>Remotees
  <td>Remote
<tr>
  <td><a href="/jobs/director">Director</a>
  <td>Remotees
  <td>Remote
<tr>
  <td><a href="/jobs/astronaut">Astronaut</a>
  <td>Architecture
  <td>Remote
</table>
<script>
document.querySelector("table").onclick = ({ target }) => {
  if (target.parentElement.localName === "tr") {
    const link = target.parentElement.querySelector("a");
    if (link) {
      link.click();
    }
  }
}
</script>

```

4.5.2 The ***em*** element



[Element/*em*](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Categories:](#)

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [em](#) element [represents](#) stress emphasis of its contents.

The level of stress that a particular piece of content has is given by its number of ancestor [em](#) elements.

The placement of stress emphasis changes the meaning of the sentence. The element thus forms an integral part of the content. The precise way in which stress is used in this way depends on the language.

These examples show how changing the stress emphasis changes the meaning. First, a general statement of fact, with no stress:

`<p>Cats are cute animals.</p>`

By emphasizing the first word, the statement implies that the kind of animal under discussion is in question (maybe someone is asserting that dogs are cute):

`<p>Cats are cute animals.</p>`

Moving the stress to the verb, one highlights that the truth of the entire sentence is in question (maybe someone is saying cats are not cute):

`<p>Cats are cute animals.</p>`

By moving it to the adjective, the exact nature of the cats is reasserted (maybe someone suggested cats were *mean* animals):

`<p>Cats are cute animals.</p>`

Similarly, if someone asserted that cats were vegetables, someone correcting this might emphasize the last word:

```
<p>Cats are cute <em>animals</em>. </p>
```

By emphasizing the entire sentence, it becomes clear that the speaker is fighting hard to get the point across. This kind of stress emphasis also typically affects the punctuation, hence the exclamation mark here.

```
<p><em>Cats are cute animals!</em></p>
```

Anger mixed with emphasizing the cuteness could lead to markup such as:

```
<p><em>Cats are <em>cute</em> animals!</em></p>
```

The [em](#) element isn't a generic "italics" element. Sometimes, text is intended to stand out from the rest of the paragraph, as if it was in a different mood or voice. For this, the [i](#) element is more appropriate.

The [em](#) element also isn't intended to convey importance; for that purpose, the [strong](#) element is more appropriate.

4.5.3 The **strong** element



[Element/strong](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [strong](#) element [represents](#) strong importance, seriousness, or urgency for its contents.

Importance: the [strong](#) element can be used in a heading, caption, or paragraph to distinguish the part that really matters from other parts that might be more detailed, more jovial, or merely boilerplate. (This is distinct from marking up subheadings, for which the [hgroup](#) element is appropriate.)

For example, the first word of the previous paragraph is marked up with [strong](#) to distinguish it from the more detailed text in the rest of the paragraph.

Seriousness: the [strong](#) element can be used to mark up a warning or caution notice.

Urgency: the [strong](#) element can be used to denote contents that the user needs to see sooner than other parts of the document.

The relative level of importance of a piece of content is given by its number of ancestor [strong](#) elements; each [strong](#) element increases the importance of its contents.

Changing the importance of a piece of text with the [strong](#) element does not change the meaning of the sentence.

Here, the word "chapter" and the actual chapter number are mere boilerplate, and the actual name of the chapter is marked up with [strong](#):

```
<h1>Chapter 1: <strong>The Praxis</strong></h1>
```

In the following example, the name of the diagram in the caption is marked up with [strong](#), to distinguish it from boilerplate text (before) and the description (after):

```
<figcaption>Figure 1. <strong>Ant colony dynamics</strong>. The ants in this ... affected by the heat source (upper left) and the food source (lower right).</caption>
```

In this example, the heading is really "Flowers, Bees, and Honey", but the author has added a light-hearted addition to the heading. The [strong](#) element is thus used to mark up the first part to distinguish it from the latter part.

```
<h1><strong>Flowers, Bees, and Honey</strong> and other things I don't unders...
```

Here is an example of a warning notice in a game, with the various parts marked up according to how important they are:

```
<p><strong>Warning.</strong> This dungeon is dangerous.  
<strong>Avoid the ducks.</strong> Take any gold you find.  
<strong><strong>Do not take any of the diamonds</strong>,  
they are explosive and <strong>will destroy anything within  
ten meters.</strong></strong> You have been warned.</p>
```

In this example, the **strong** element is used to denote the part of the text that the user is intended to read first.

```
<p>Welcome to Remy, the reminder system.</p>  
<p>Your tasks for today:</p>  
<ul>  
<li><p><strong>Turn off the oven.</strong></p></li>  
<li><p>Put out the trash.</p></li>  
<li><p>Do the laundry.</p></li>  
</ul>
```

4.5.4 The **small** element



[Element/small](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [**small**](#) element [represents](#) side comments such as small print.

Small print typically features disclaimers, caveats, legal restrictions, or copyrights. Small print is also sometimes used for attribution, or for satisfying licensing requirements.

The [**small**](#) element does not "de-emphasize" or lower the importance of text emphasized by the [**em**](#) element or marked as important with the [**strong**](#) element. To mark text as not emphasized or important, simply do not mark it up with the [**em**](#) or [**strong**](#) elements respectively.

The [**small**](#) element should not be used for extended spans of text, such as multiple paragraphs, lists, or sections of text. It is only intended for short runs of text. The text of a page listing terms of use, for instance, would not be a suitable candidate for the [**small**](#) element: in such a case, the text is not a side comment, it is the main content of the page.

The [**small**](#) element must not be used for subheadings; for that purpose, use the [hgroup](#) element.

In this example, the [**small**](#) element is used to indicate that value-added tax is not included in a price of a hotel room:

```
<dl>
  <dt>Single room
  <dd>199 € <small>breakfast included, VAT not included</small>
  <dt>Double room
  <dd>239 € <small>breakfast included, VAT not included</small>
</dl>
```

In this second example, the [**small**](#) element is used for a side comment in an article.

```
<p>Example Corp today announced record profits for the
second quarter <small>(Full Disclosure: Foo News is a subsidiary of
Example Corp)</small>, leading to speculation about a third quarter
merger with Demo Group.</p>
```

This is distinct from a sidebar, which might be multiple paragraphs long and is removed from the main flow of text. In the following example, we see a sidebar from the same article. This sidebar also has small print, indicating the source of the information in the sidebar.

```
<aside>
  <h1>Example Corp</h1>
  <p>This company mostly creates small software and Web
  sites.</p>
  <p>The Example Corp company mission is "To provide entertainment
  and news on a sample basis".</p>
  <p><small>Information obtained from <a
  href="https://example.com/about.html">example.com</a> home
  page.</small></p>
</aside>
```

In this last example, the `small` element is marked as being *important* small print.

```
<p><strong><small>Continued use of this service will result in a kiss.</small>
```

4.5.5 The `s` element

MDN

Element/s

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

Flow content.

Phrasing content.

Palpable content.

Contexts in which this element can be used:

Where phrasing content is expected.

Content model:

Phrasing content.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTMLElement](#).

The **s** element [represents](#) contents that are no longer accurate or no longer relevant.

The **s** element is not appropriate when indicating document edits; to mark a span of text as having been removed from a document, use the **del** element.

In this example a recommended retail price has been marked as no longer relevant as the product in question has a new sale price.

```
<p>Buy our Iced Tea and Lemonade!</p>
<p><s>Recommended retail price: $3.99 per bottle</s></p>
<p><strong>Now selling for just $2.99 a bottle!</strong></p>
```

4.5.6 The **cite** element



[Element/cite](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

Flow content.

Phrasing content.

Palpable content.

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

Phrasing content.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTMLElement](#).

The [cite](#) element [represents](#) the title of a work (e.g. a book, a paper, an essay, a poem, a score, a song, a script, a film, a TV show, a game, a sculpture, a painting, a theatre production, a play, an opera, a musical, an exhibition, a legal case report, a computer program, etc.). This can be a work that is being quoted or [referenced](#) in detail (i.e., a citation), or it can just be a work that is mentioned in passing.

A person's name is not the title of a work — even if people call that person a piece of work — and the element must therefore not be used to mark up people's names. (In some cases, the [b](#) element might be appropriate for names; e.g. in a gossip article where the names of famous people are keywords rendered with a different style to draw attention to them. In other cases, if an element is *really* needed, the [span](#) element can be used.)

This next example shows a typical use of the [cite](#) element:

```
<p>My favorite book is <cite>The Reality Dysfunction</cite> by Peter F. Hamilton. My favorite comic is <cite>Pearls Before Swine</cite> by Stephan Pastis. My favorite track is <cite>Jive Samba</cite> by the Cannonball Adderley Sextet.</p>
```

This is correct usage:

```
<p>According to the Wikipedia article <cite>HTML</cite>, as it stood in mid-February 2008, leaving attribute values unquoted is unsafe. This is obviously an over-simplification.</p>
```

The following, however, is incorrect usage, as the [cite](#) element here is containing far more than the title of the work:

```
<!-- do not copy this example, it is an example of bad usage! -->
<p>According to <cite>the Wikipedia article on HTML</cite>, as it stood in mid-February 2008, leaving attribute values unquoted is
```

unsafe. This is obviously an over-simplification.</p>

The [cite](#) element is obviously a key part of any citation in a bibliography, but it is only used to mark the title:

```
<p><cite>Universal Declaration of Human Rights</cite>, United Nations, December 1948. Adopted by General Assembly resolution 217 A (III).</p>
```

A *citation* is not a *quote* (for which the [q](#) element is appropriate).

This is incorrect usage, because [cite](#) is not for quotes:

```
<p><cite>This is wrong!</cite>, said Ian.</p>
```

This is also incorrect usage, because a person is not a work:

```
<p><q>This is still wrong!</q>, said <cite>Ian</cite>.</p>
```

The correct usage does not use a [cite](#) element:

```
<p><q>This is correct</q>, said Ian.</p>
```

As mentioned above, the [b](#) element might be relevant for marking names as being keywords in certain kinds of documents:

```
<p>And then <b>Ian</b> said <q>this might be right, in a gossip column, maybe!</q>.</p>
```

4.5.7 The [q](#) element



[Element/q](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

cite — Link to the source of the quotation or more information about the edit

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

Uses [HTMLQuoteElement](#).

The **q** element [represents](#) some [phrasing content](#) quoted from another source.

Quotation punctuation (such as quotation marks) that is quoting the contents of the element must not appear immediately before, after, or inside **q** elements; they will be inserted into the rendering by the user agent.

Content inside a **q** element must be quoted from another source, whose address, if it has one, may be cited in the **cite** attribute. The source may be fictional, as when quoting characters in a novel or screenplay.

If the **cite** attribute is present, it must be a [valid URL potentially surrounded by spaces](#). To obtain the corresponding citation link, the value of the attribute must be [parsed](#) relative to the element's [node document](#). User agents may allow users to follow such citation links, but they are primarily intended for private use (e.g., by server-side scripts collecting statistics about a site's use of quotations), not for readers.

The **q** element must not be used in place of quotation marks that do not represent quotes; for example, it is inappropriate to use the **q** element for marking up sarcastic statements.

The use of **q** elements to mark up quotations is entirely optional; using explicit quotation punctuation without **q** elements is just as correct.

Here is a simple example of the use of the **q** element:

```
<p>The man said <q>Things that are impossible just take  
longer</q>. I disagreed with him.</p>
```

Here is an example with both an explicit citation link in the [q](#) element, and an explicit citation outside:

```
<p>The W3C page <cite>About W3C</cite> says the W3C's  
mission is <q cite="https://www.w3.org/Consortium/">To lead the  
World Wide Web to its full potential by developing protocols and  
guidelines that ensure long-term growth for the Web</q>. I  
disagree with this mission.</p>
```

In the following example, the quotation itself contains a quotation:

```
<p>In <cite>Example One</cite>, he writes <q>The man  
said <q>Things that are impossible just take longer</q>. I  
disagreed with him</q>. Well, I disagree even more!</p>
```

In the following example, quotation marks are used instead of the [q](#) element:

```
<p>His best argument was "I disagree", which  
I thought was laughable.</p>
```

In the following example, there is no quote — the quotation marks are used to name a word. Use of the [q](#) element in this case would be inappropriate.

```
<p>The word "ineffable" could have been used to describe the disaster  
resulting from the campaign's mismanagement.</p>
```

4.5.8 The **dfn** element



[Element/dfn](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where phrasing content is expected.

Content model:

Phrasing content, but there must be no **dfn** element descendants.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Also, the **title** attribute has special semantics on this element: Full term or expansion of abbreviation.

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses **HTMLElement**.

The **dfn** element represents the defining instance of a term. The paragraph, description list group, or section that is the nearest ancestor of the **dfn** element must also contain the definition(s) for the term given by the **dfn** element.

Defining term: if the **dfn** element has a **title** attribute, then the exact value of that attribute is the term being defined. Otherwise, if it contains exactly one element child node and no child Text nodes, and that child element is an **abbr** element with a **title** attribute, then the exact value of *that* attribute is the term being defined. Otherwise, it is the descendant text content of the **dfn** element that gives the term being defined.

If the **title** attribute of the **dfn** element is present, then it must contain only the term being defined.

The **title** attribute of ancestor elements does not affect **dfn** elements.

An **a** element that links to a **dfn** element represents an instance of the term defined by the **dfn** element.

In the following fragment, the term "Garage Door Opener" is first defined in the first paragraph, then used in the second. In both cases, its abbreviation is what is actually displayed.

```
<p>The <dfn><abbr title="Garage Door Opener">GDO</abbr></dfn>
is a device that allows off-world teams to open the iris.</p>
<!-- ... later in the document: -->
<p>Teal'c activated his <abbr title="Garage Door Opener">GDO</abbr>
```

and so Hammond ordered the iris to be opened.</p>

With the addition of an [a](#) element, the [reference](#) can be made explicit:

```
<p>The <dfn id=gdo><abbr title="Garage Door Opener">GDO</abbr></dfn>  
is a device that allows off-world teams to open the iris.</p>  
<!-- ... later in the document: -->  
<p>Teal'c activated his <a href=#gdo><abbr title="Garage Door Opener">GDO</abbr>  
and so Hammond ordered the iris to be opened.</p>
```

4.5.9 The **abbr** element



[Element/abbr](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 2+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 7+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

Also, the [title](#) attribute [has special semantics](#) on this element: Full term or expansion of abbreviation.

[Accessibility considerations:](#)

[For authors](#).

For implementers.

DOM interface:

Uses [HTMLElement](#).

The [abbr](#) element [represents](#) an abbreviation or acronym, optionally with its expansion. The [title](#) attribute may be used to provide an expansion of the abbreviation. The attribute, if specified, must contain an expansion of the abbreviation, and nothing else.

The paragraph below contains an abbreviation marked up with the [abbr](#) element. This paragraph [defines the term](#) "Web Hypertext Application Technology Working Group".

```
<p>The <dfn id=whatwg><abbr  
title="Web Hypertext Application Technology Working Group">WHATWG</abbr></dfn>  
is a loose unofficial collaboration of web browser manufacturers and  
interested parties who wish to develop new technologies designed to  
allow authors to write and deploy Applications over the World Wide  
Web.</p>
```

An alternative way to write this would be:

```
<p>The <dfn id=whatwg>Web Hypertext Application Technology  
Working Group</dfn> (<abbr  
title="Web Hypertext Application Technology Working Group">WHATWG</abbr>)  
is a loose unofficial collaboration of web browser manufacturers and  
interested parties who wish to develop new technologies designed to  
allow authors to write and deploy Applications over the World Wide  
Web.</p>
```

This paragraph has two abbreviations. Notice how only one is defined; the other, with no expansion associated with it, does not use the [abbr](#) element.

```
<p>The  
<abbr title="Web Hypertext Application Technology Working Group">WHATWG</abbr>  
started working on HTML5 in 2004.</p>
```

This paragraph links an abbreviation to its definition.

```
<p>The <a href="#whatwg"><abbr  
title="Web Hypertext Application Technology Working Group">WHATWG</abbr></a>  
community does not have much representation from Asia.</p>
```

This paragraph marks up an abbreviation without giving an expansion, possibly as a hook to apply styles for abbreviations (e.g. smallcaps).

```
<p>Philip` and Dashiva both denied that they were going to  
get the issue counts from past revisions of the specification to  
backfill the <abbr>WHATWG</abbr> issue graph.</p>
```

If an abbreviation is pluralized, the expansion's grammatical number (plural vs singular) must match the grammatical number of the contents of the element.

Here the plural is outside the element, so the expansion is in the singular:

```
<p>Two <abbr title="Working Group">WG</abbr>s worked on  
this specification: the <abbr>WHATWG</abbr> and the  
<abbr>HTMLWG</abbr>. </p>
```

Here the plural is inside the element, so the expansion is in the plural:

```
<p>Two <abbr title="Working Groups">WGs</abbr> worked on  
this specification: the <abbr>WHATWG</abbr> and the  
<abbr>HTMLWG</abbr>. </p>
```

Abbreviations do not have to be marked up using this element. It is expected to be useful in the following cases:

- Abbreviations for which the author wants to give expansions, where using the [abbr](#) element with a [title](#) attribute is an alternative to including the expansion inline (e.g. in parentheses).
- Abbreviations that are likely to be unfamiliar to the document's readers, for which authors are encouraged to either mark up the abbreviation using an [abbr](#) element with a [title](#) attribute or include the expansion inline in the text the first time the abbreviation is used.
- Abbreviations whose presence needs to be semantically annotated, e.g. so that they can be identified from a style sheet and given specific styles, for which the [abbr](#) element can be used without a [title](#) attribute.

Providing an expansion in a [title](#) attribute once will not necessarily cause other [abbr](#) elements in the same document with the same contents but without a [title](#) attribute to behave as if they had the same expansion. Every [abbr](#) element is independent.

4.5.10 The **ruby** element



[Element/ruby](#)

Support in all current engines.

Firefox 38+ Safari 5+ Chrome 5+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 38+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 14+

Categories:

Flow content.

Phrasing content.

Palpable content.

Contexts in which this element can be used:

Where phrasing content is expected.

Content model:

See prose.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTMLElement](#).

The [ruby](#) element allows one or more spans of phrasing content to be marked with ruby annotations. Ruby annotations are short runs of text presented alongside base text, primarily used in East Asian typography as a guide for pronunciation or to include other annotations. In Japanese, this form of typography is also known as *furigana*.

The content model of [ruby](#) elements consists of one or more of the following sequences:

1. One or the other of the following:
 - [Phrasing content](#), but with no [ruby](#) elements and with no [ruby](#) element descendants
 - A single [ruby](#) element that itself has no [ruby](#) element descendants
2. One or the other of the following:
 - One or more [rt](#) elements
 - An [rp](#) element followed by one or more [rt](#) elements, each of which is itself followed by an [rp](#) element

The [ruby](#) and [rt](#) elements can be used for a variety of kinds of annotations, including in particular (though by no means limited to) those described below. For more details on Japanese Ruby in particular, and how to render Ruby for Japanese, see *Requirements for Japanese Text Layout*. [\[JLREQ\]](#)

At the time of writing, CSS does not yet provide a way to fully control the rendering of the HTML [ruby](#) element. It is hoped that CSS will be extended to support the styles described below in due course.

Mono-ruby for individual base characters in Japanese

One or more hiragana or katakana characters (the ruby annotation) are placed with each ideographic character (the base text). This is used to provide readings of kanji characters.

```
<ruby>B<rt>annotation</ruby>
```

In this example, notice how each annotation corresponds to a single base character.

```
<ruby>君<rt>くん</ruby><ruby>子<rt>こ</ruby>は<ruby>和<rt>わ</ruby>して<ruby>同<rt>どう
```

君くん子こはわして同どうぜず。

This example can also be written as follows, using one [ruby](#) element with two segments of base text and two annotations (one for each) rather than two back-to-back [ruby](#) elements each with one base text segment and annotation (as in the markup above):

```
<ruby>君<rt>くん</rt>子<rt>こ</rt>は<ruby>和<rt>わ</ruby>して<ruby>同<rt>どう
```

Mono-ruby for compound words (jukugo)

This is similar to the previous case: each ideographic character in the compound word (the base text) has its reading given in hiragana or katakana characters (the ruby annotation). The difference is that the base text segments form a compound word rather than being separate from each other.

```
<ruby>B<rt>annotation</rt>B<rt>annotation</ruby>
```

In this example, notice again how each annotation corresponds to a single base character. In this example, each compound word (jukugo) corresponds to a single [ruby](#) element.

The rendering here is expected to be that each annotation be placed over (or next to, in vertical text) the corresponding base character, with the annotations not overhanging any of the adjacent characters.

```
<ruby>鬼<rt>き</rt>門<rt>もん</rt></ruby>の<ruby>方<rt>ほう</rt>角<rt>かど</rt>がく</rt>
```

鬼き門もんの方ほう角かどを凝ぎょう視しする

Jukugo-ruby

This is semantically identical to the previous case (each individual ideographic character in the base compound word has its reading given in an annotation in hiragana or katakana characters), but the rendering is the more complicated Jukugo Ruby rendering.

This is the same example as above for mono-ruby for compound words. The different rendering is expected to be achieved using different styling (e.g. in CSS), and is not shown here.

```
<ruby>鬼<rt>き</rt>門<rt>もん</rt></ruby>の<ruby>方<rt>ほう</rt>角<rt>かく</rt>
```

For more details on [Jukugo Ruby rendering](#), see Appendix F in the *Requirements for Japanese Text Layout*. [\[JLREQ\]](#)

Group ruby for describing meanings

The annotation describes the meaning of the base text, rather than (or in addition to) the pronunciation. As such, both the base text and the annotation can be multiple characters long.

```
<ruby>BASE<rt>annotation</ruby>
```

Here a compound ideographic word has its corresponding katakana given as an annotation.

```
<ruby>境界面<rt>インタ?フェ?ス</ruby>
```

境界面 インタ?フェ?ス

Here a compound ideographic word has its translation in English provided as an annotation.

```
<ruby lang="ja">編集者<rt lang="en">editor</ruby>
```

編集者 editor

Group ruby for Jukuji readings

A phonetic reading that corresponds to multiple base characters, because a one-to-one mapping would be difficult. (In English, the words "Colonel" and "Lieutenant" are examples of words where a direct mapping of pronunciation to individual letters is, in some dialects, rather unclear.)

In this example, the name of a species of flowers has a phonetic reading provided using group ruby:

```
<ruby>紫陽花<rt>あじさい</ruby>
```

紫陽花 あじさい

Text with both phonetic and semantic annotations (double-sided ruby)

Sometimes, ruby styles described above are combined.

If this results in two annotations covering the same single base segment, then the annotations can just be placed back to back.

```
<ruby>BASE<rt>annotation 1<rt>annotation 2</ruby>  
  
<ruby>B<rt>a<rt>a</ruby><ruby>A<rt>a<rt>a</ruby><ruby>S<rt>a<rt>a</ruby><r
```

In this contrived example, some symbols are given names in English and French.

```
<ruby>  
  ♥ <rt> Heart <rt lang=fr> Cœur </rt>  
  ✪ <rt> Shamrock <rt lang=fr> Trèfle </rt>  
  * <rt> Star <rt lang=fr> Étoile </rt>  
</ruby>
```

In more complication situations such as following examples, a nested `ruby` element is used to give the inner annotations, and then that whole `ruby` is then given an annotation at the "outer" level.

```
<ruby><ruby>B<rt>a</rt>A<rt>n</rt>S<rt>t</rt>E<rt>n</rt></ruby><rt>annotat
```

Here both a phonetic reading and the meaning are given in ruby annotations. The annotation on the nested `ruby` element gives a mono-ruby phonetic annotation for each base character, while the annotation in the `rt` element that is a child of the outer `ruby` element gives the meaning using hiragana.

```
<ruby><ruby>東<rt>とう</rt>南<rt>なん</rt></ruby><rt>たつみ</rt></ruby>の方角  
東とう南なんたつみの方角
```

This is the same example, but the meaning is given in English instead of Japanese:

```
<ruby><ruby>東<rt>とう</rt>南<rt>なん</rt></ruby><rt lang=en>Southeast</rt><br/>  
東とう南なんSoutheastの方角
```

Within a `ruby` element that does not have a `ruby` element ancestor, content is segmented and segments are placed into three categories: base text segments, annotation segments, and ignored segments. Ignored segments do not form part of the document's semantics (they consist of some [inter-element whitespace](#) and `rp` elements, the latter of which are used for legacy user agents that do not support ruby at all). Base text segments can overlap (with a limit of two segments overlapping any one position in the DOM, and with any segment having an earlier start point than an overlapping segment also having an equal or later end point, and any segment have a later end point than an overlapping segment also having an equal or earlier start point). Annotation segments correspond to `rt` elements. Each annotation segment can be associated with a base text segment, and each base text segment can have annotation segments

associated with it. (In a conforming document, each base text segment is associated with at least one annotation segment, and each annotation segment is associated with one base text segment.) A [ruby](#) element [represents](#) the union of the segments of base text it contains, along with the mapping from those base text segments to annotation segments. Segments are described in terms of DOM ranges; annotation segment ranges always consist of exactly one element. [\[DOM\]](#)

At any particular time, the segmentation and categorization of content of a [ruby](#) element is the result that would be obtained from running the following algorithm:

1. Let *base text segments* be an empty list of base text segments, each potentially with a list of base text subsegments.
2. Let *annotation segments* be an empty list of annotation segments, each potentially being associated with a base text segment or subsegment.
3. Let *root* be the [ruby](#) element for which the algorithm is being run.
4. If *root* has a [ruby](#) element ancestor, then jump to the step labeled *end*.
5. Let *current parent* be *root*.
6. Let *index* be 0.
7. Let *start index* be null.
8. Let *parent start index* be null.
9. Let *current base text* be null.
10. *Start mode*: If *index* is equal to or greater than the number of child nodes in *current parent*, then jump to the step labeled *end mode*.
11. If the *index*th node in *current parent* is an [rt](#) or [rp](#) element, jump to the step labeled *annotation mode*.
12. Set *start index* to the value of *index*.
13. *Base mode*: If the *index*th node in *current parent* is a [ruby](#) element, and if *current parent* is the same element as *root*, then [push a ruby level](#) and then jump to the step labeled *start mode*.
14. If the *index*th node in *current parent* is an [rt](#) or [rp](#) element, then [set the current base text](#) and then jump to the step labeled *annotation mode*.
15. Increment *index* by one.
16. *Base mode post-increment*: If *index* is equal to or greater than the number of child

- nodes in *current parent*, then jump to the step labeled *end mode*.
17. Jump back to the step labeled *base mode*.
 18. *Annotation mode*: If the *indexeth* node in *current parent* is an [rt](#) element, then [push a ruby annotation](#) and jump to the step labeled *annotation mode increment*.
 19. If the *indexeth* node in *current parent* is an [rp](#) element, jump to the step labeled *annotation mode increment*.
 20. If the *indexeth* node in *current parent* is not a [Text](#) node, or is a [Text](#) node that is not [inter-element whitespace](#), then jump to the step labeled *base mode*.
 21. *Annotation mode increment*: Let *lookahead index* be *index* plus one.
 22. *Annotation mode white-space skipper*: If *lookahead index* is equal to the number of child nodes in *current parent* then jump to the step labeled *end mode*.
 23. If the *lookahead indexeth* node in *current parent* is an [rt](#) element or an [rp](#) element, then set *index* to *lookahead index* and jump to the step labeled *annotation mode*.
 24. If the *lookahead indexeth* node in *current parent* is not a [Text](#) node, or is a [Text](#) node that is not [inter-element whitespace](#), then jump to the step labeled *base mode* (without further incrementing *index*, so the [inter-element whitespace](#) seen so far becomes part of the next base text segment).
 25. Increment *lookahead index* by one.
 26. Jump to the step labeled *annotation mode white-space skipper*.
 27. *End mode*: If *current parent* is not the same element as *root*, then [pop a ruby level](#) and jump to the step labeled *base mode post-increment*.
 28. *End*: Return *base text segments* and *annotation segments*. Any content of the [ruby](#) element not described by segments in either of those lists is implicitly in an *ignored segment*.

When the steps above say to *set the current base text*, it means to run the following steps at that point in the algorithm:

1. Let *text range* be a DOM range whose [start](#) is the [boundary point](#) (*current parent*, *start index*) and whose [end](#) is the [boundary point](#) (*current parent*, *index*).
2. Let *new text segment* be a base text segment described by the range *annotation range*.
3. Add *new text segment* to *base text segments*.
4. Let *current base text* be *new text segment*.

5. Let *start index* be null.

When the steps above say to *push a ruby level*, it means to run the following steps at that point in the algorithm:

1. Let *current parent* be the *index*th node in *current parent*.
2. Let *index* be 0.
3. Set *saved start index* to the value of *start index*.
4. Let *start index* be null.

When the steps above say to *pop a ruby level*, it means to run the following steps at that point in the algorithm:

1. Let *index* be the position of *current parent* in *root*.
2. Let *current parent* be *root*.
3. Increment *index* by one.
4. Set *start index* to the value of *saved start index*.
5. Let *saved start index* be null.

When the steps above say to *push a ruby annotation*, it means to run the following steps at that point in the algorithm:

1. Let *rt* be the [rt](#) element that is the *index*th node of *current parent*.
2. Let *annotation range* be a DOM range whose [start](#) is the [boundary point](#) (*current parent*, *index*) and whose [end](#) is the [boundary point](#) (*current parent*, *index* plus one) (i.e. that contains only *rt*).
3. Let *new annotation segment* be an annotation segment described by the range *annotation range*.
4. If *current base text* is not null, associate *new annotation segment* with *current base text*.
5. Add *new annotation segment* to *annotation segments*.

In this example, each ideograph in the Japanese text 漢字 is annotated with its reading in hiragana.

...
<ruby>漢<rt>かん</rt>字<rt>じ</rt></ruby>

...

This might be rendered as:

かんじ
... 漢字 ...

In this example, each ideograph in the traditional Chinese text 漢字 is annotated with its bopomofo reading.

```
<ruby>漢<rt>??`</rt>字<rt>?'</rt></ruby>
```

This might be rendered as:

漢 hàn
字 zì

In this example, each ideograph in the simplified Chinese text ?字 is annotated with its pinyin reading.

```
...<ruby>?<rt>hàn</rt>字<rt>zì</rt></ruby>...
```

This might be rendered as:

hàn zì
... 汉字 ...

In this more contrived example, the acronym "HTML" has four annotations: one for the whole acronym, briefly describing what it is, one for the letters "HT" expanding them to "Hypertext", one for the letter "M" expanding it to "Markup", and one for the letter "L" expanding it to "Language".

```
<ruby>  
  <ruby>HT<rt>Hypertext</rt>M<rt>Markup</rt>L<rt>Language</rt></ruby>  
  <rt>An abstract language for describing documents and applications  
</ruby>
```

4.5.11 The ***rt*** element

✓MDN

[Element/rt](#)

Support in all current engines.

Firefox 38+ Safari 5+ Chrome 5+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer 5+

Firefox Android 38+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 14+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As a child of a [ruby](#) element.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

An [rt](#) element's [end tag](#) can be omitted if the [rt](#) element is immediately followed by an [rt](#) or [rp](#) element, or if there is no more content in the parent element.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [rt](#) element marks the ruby text component of a ruby annotation. When it is the child of a [ruby](#) element, it doesn't [represent](#) anything itself, but the [ruby](#) element uses it as part of determining what *it* [represents](#).

An [rt](#) element that is not a child of a [ruby](#) element [represents](#) the same thing as its children.

4.5.12 The ***rp*** element

✓MDN

[Element/rp](#)

Support in all current engines.

Firefox 38+ Safari 5+ Chrome 5+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer 5+

Firefox Android 38+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 14+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As a child of a [ruby](#) element, either immediately before or immediately after an [rt](#) element.

[Content model:](#)

[Text](#).

[Tag omission in text/html:](#)

An [rp](#) element's [end tag](#) can be omitted if the [rp](#) element is immediately followed by an [rt](#) or [rp](#) element, or if there is no more content in the parent element.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

Uses [HTMLElement](#).

The [rp](#) element can be used to provide parentheses or other content around a ruby text component of a ruby annotation, to be shown by user agents that don't support ruby annotations.

An [rp](#) element that is a child of a [ruby](#) element [represents](#) nothing. An [rp](#) element whose parent element is not a [ruby](#) element [represents](#) its children.

The example above, in which each ideograph in the text 漢字 is annotated with its phonetic reading, could be expanded to use [rp](#) so that in legacy user agents the readings are in parentheses:

```
...<ruby>漢<rp> (</rp><rt>かん</rt><rp>) </rp>字<rp> (</rp><rt>じ</rt><rp>) </rp></...>
```

In conforming user agents the rendering would be as above, but in user agents that do not support ruby, the rendering would be:

... 漢 (かん) 字 (じ) ...

When there are multiple annotations for a segment, `rp` elements can also be placed between the annotations. Here is another copy of an earlier contrived example showing some symbols with names given in English and French, but this time with `rp` elements as well:

```
<ruby>
  ♥<rp>: </rp><rt>Heart</rt><rp>, </rp><rt lang=fr>Cœur</rt><rp>. </rp>
  *<rp>: </rp><rt>Shamrock</rt><rp>, </rp><rt lang=fr>Trèfle</rt><rp>. </rp>
  *<rp>: </rp><rt>Star</rt><rp>, </rp><rt lang=fr>Étoile</rt><rp>. </rp>
</ruby>
```

This would make the example render as follows in non-ruby-capable user agents:

♥: Heart, Cœur. *: Shamrock, Trèfle. *: Star, Étoile.

4.5.13 The **data** element



[Element/data](#)

Support in all current engines.

Firefox 22+ Safari 10+ Chrome 62+

Opera 49+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 22+ Safari iOS 10+ Chrome Android 62+ WebView Android 62+ Samsung Internet 8.0+ Opera Android 46+



[HTMLDataElement](#)

Support in all current engines.

Firefox 22+ Safari 10+ Chrome 62+

Opera 49+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 22+ Safari iOS 10+ Chrome Android 62+ WebView Android 62+ Samsung Internet 8.0+ Opera Android 46+

[Categories:](#)

[Flow content](#)

[Phrasing content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[**value**](#) — Machine-readable value

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLDataElement : HTMLElement {
  [HTMLConstructor] constructor();
  [CEReactions] attribute DOMString value;
};
```

The [data](#) element [represents](#) its contents, along with a machine-readable form of those contents in the [**value**](#) attribute.

The **value** attribute must be present. Its value must be a representation of the element's contents in a machine-readable format.

When the value is date- or time-related, the more specific [**time**](#) element can be used instead.

The element can be used for several purposes.

When combined with microformats or the [microdata attributes](#) defined in this specification, the element serves to provide both a machine-readable value for the purposes of data processors, and a human-readable value for the purposes of rendering in a web browser. In this case, the format to be used in the [**value**](#) attribute is determined by the microformats or microdata vocabulary in use.

The element can also, however, be used in conjunction with scripts in the page, for when a

script has a literal value to store alongside a human-readable value. In such cases, the format to be used depends only on the needs of the script. (The `data-*` attributes can also be useful in such situations.)



[HTMLDataElement/value](#)

Support in all current engines.

Firefox 22+ Safari 10+ Chrome 62+

Opera 49+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 22+ Safari iOS 10+ Chrome Android 62+ WebView Android 62+ Samsung Internet 8.0+ Opera Android 46+

The `value` IDL attribute must [reflect](#) the content attribute of the same name.

Here, a short table has its numeric values encoded using the `data` element so that the table sorting JavaScript library can provide a sorting mechanism on each column despite the numbers being presented in textual form in one column and in a decomposed form in another.

```
<script src="sortable.js"></script>
<table class="sortable">
  <thead> <tr> <th> Game <th> Corporations <th> Map Size
  <tbody>
    <tr> <td> 1830 <td> <data value="8">Eight</data> <td> <data value="93">19+7</data>
    <tr> <td> 1856 <td> <data value="11">Eleven</data> <td> <data value="99">12+1</data>
    <tr> <td> 1870 <td> <data value="10">Ten</data> <td> <data value="149">4+145</data>
  </tbody>
```

4.5.14 The `time` element



[Element/time](#)

Support in all current engines.

Firefox 22+ Safari 7+ Chrome 62+

Opera 49+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 22+ Safari iOS 4+ Chrome Android 62+ WebView Android 62+ Samsung Internet 8.0+ Opera Android 46+



[HTMLTimeElement](#)

Support in all current engines.

Firefox 22+ Safari 10+ Chrome 62+

Opera 49+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 22+ Safari iOS 10+ Chrome Android 62+ WebView Android 62+ Samsung Internet 8.0+ Opera Android 46+

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

If the element has a [datetime](#) attribute: [Phrasing content](#).

Otherwise: [Text](#), but must match requirements described in prose below.

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[datetime](#) — Machine-readable value

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLTimeElement : HTMLElement {
  [HTMLConstructor] constructor();
  [CEReactions] attribute DOMString dateTIme;
};
```

The [time](#) element [represents](#) its contents, along with a machine-readable form of those contents in the [datetime](#) attribute. The kind of content is limited to various kinds of dates, times, time-zone offsets, and durations, as described below.

The **`datetime`** attribute may be present. If present, its value must be a representation of the element's contents in a machine-readable format.

A **`time`** element that does not have a **`datetime`** content attribute must not have any element descendants.

The *datetime value* of a **`time`** element is the value of the element's **`datetime`** content attribute, if it has one, otherwise the **child text content** of the **`time`** element.

The **datetime value** of a **`time`** element must match one of the following syntaxes.

A **valid month string**

```
<time>2011-11</time>
```

A **valid date string**

```
<time>2011-11-18</time>
```

A **valid yearless date string**

```
<time>11-18</time>
```

A **valid time string**

```
<time>14:54</time>
```

```
<time>14:54:39</time>
```

```
<time>14:54:39.929</time>
```

A **valid local date and time string**

```
<time>2011-11-18T14:54</time>
```

```
<time>2011-11-18T14:54:39</time>
```

```
<time>2011-11-18T14:54:39.929</time>
```

```
<time>2011-11-18 14:54</time>
```

```
<time>2011-11-18 14:54:39</time>
```

```
<time>2011-11-18 14:54:39.929</time>
```

Times with dates but without a time zone offset are useful for specifying events that are observed at the same specific time in each time zone, throughout a day. For example, the 2020 new year is celebrated at 2020-01-01 00:00 in each time zone, not at the same precise

moment across all time zones. For events that occur at the same time across all time zones, for example a videoconference meeting, a [valid global date and time string](#) is likely more useful.

A [valid time-zone offset string](#)

```
<time>Z</time>  
<time>+0000</time>  
<time>+00:00</time>  
<time>-0800</time>  
<time>-08:00</time>
```

For times without dates (or times referring to events that recur on multiple dates), specifying the geographic location that controls the time is usually more useful than specifying a time zone offset, because geographic locations change time zone offsets with daylight saving time. In some cases, geographic locations even change time zone, e.g. when the boundaries of those time zones are redrawn, as happened with Samoa at the end of 2011. There exists a time zone database that describes the boundaries of time zones and what rules apply within each such zone, known as the *time zone database*. [\[TZDATABASE\]](#)

A [valid global date and time string](#)

```
<time>2011-11-18T14:54Z</time>  
<time>2011-11-18T14:54:39Z</time>  
<time>2011-11-18T14:54:39.929Z</time>  
<time>2011-11-18T14:54+0000</time>  
<time>2011-11-18T14:54:39+0000</time>  
<time>2011-11-18T14:54:39.929+0000</time>  
<time>2011-11-18T14:54+00:00</time>  
<time>2011-11-18T14:54:39+00:00</time>  
<time>2011-11-18T14:54:39.929+00:00</time>  
<time>2011-11-18T06:54-0800</time>  
<time>2011-11-18T06:54:39-0800</time>
```

```
<time>2011-11-18T06:54:39.929-0800</time>  
  
<time>2011-11-18T06:54-08:00</time>  
  
<time>2011-11-18T06:54:39-08:00</time>  
  
<time>2011-11-18T06:54:39.929-08:00</time>  
  
<time>2011-11-18 14:54Z</time>  
  
<time>2011-11-18 14:54:39Z</time>  
  
<time>2011-11-18 14:54:39.929Z</time>  
  
<time>2011-11-18 14:54+0000</time>  
  
<time>2011-11-18 14:54:39+0000</time>  
  
<time>2011-11-18 14:54:39.929+0000</time>  
  
<time>2011-11-18 14:54+00:00</time>  
  
<time>2011-11-18 14:54:39+00:00</time>  
  
<time>2011-11-18 14:54:39.929+00:00</time>  
  
<time>2011-11-18 06:54-0800</time>  
  
<time>2011-11-18 06:54:39-0800</time>  
  
<time>2011-11-18 06:54:39.929-0800</time>  
  
<time>2011-11-18 06:54-08:00</time>  
  
<time>2011-11-18 06:54:39-08:00</time>  
  
<time>2011-11-18 06:54:39.929-08:00</time>
```

Times with dates and a time zone offset are useful for specifying specific events, or recurring virtual events where the time is not anchored to a specific geographic location. For example, the precise time of an asteroid impact, or a particular meeting in a series of meetings held at 1400 UTC every day, regardless of whether any particular part of the world is observing daylight saving time or not. For events where the precise time varies by the local time zone offset of a specific geographic location, a [valid local date and time string](#) combined with that geographic location is likely more useful.

A [valid week string](#)

```
<time>2011-W47</time>
```

Four or more [ASCII digits](#), at least one of which is not U+0030 DIGIT ZERO (0)

```
<time>2011</time>
```

```
<time>0001</time>
```

A [valid duration string](#)

```
<time>PT4H18M3S</time>
```

```
<time>4h 18m 3s</time>
```

The *machine-readable equivalent of the element's contents* must be obtained from the element's [datetime value](#) by using the following algorithm:

1. If [parsing a month string](#) from the element's [datetime value](#) returns a [month](#), that is the machine-readable equivalent; return.
2. If [parsing a date string](#) from the element's [datetime value](#) returns a [date](#), that is the machine-readable equivalent; return.
3. If [parsing a yearless date string](#) from the element's [datetime value](#) returns a [yearless date](#), that is the machine-readable equivalent; return.
4. If [parsing a time string](#) from the element's [datetime value](#) returns a [time](#), that is the machine-readable equivalent; return.
5. If [parsing a local date and time string](#) from the element's [datetime value](#) returns a [local date and time](#), that is the machine-readable equivalent; return.
6. If [parsing a time-zone offset string](#) from the element's [datetime value](#) returns a [time-zone offset](#), that is the machine-readable equivalent; return.
7. If [parsing a global date and time string](#) from the element's [datetime value](#) returns a [global date and time](#), that is the machine-readable equivalent; return.
8. If [parsing a week string](#) from the element's [datetime value](#) returns a [week](#), that is the machine-readable equivalent; return.
9. If the element's [datetime value](#) consists of only [ASCII digits](#), at least one of which is not U+0030 DIGIT ZERO (0), then the machine-readable equivalent is the base-ten interpretation of those digits, representing a year; return.
10. If [parsing a duration string](#) from the element's [datetime value](#) returns a [duration](#), that

is the machine-readable equivalent; return.

11. There is no machine-readable equivalent.

The algorithms referenced above are intended to be designed such that for any arbitrary string *s*, only one of the algorithms returns a value. A more efficient approach might be to create a single algorithm that parses all these data types in one pass; developing such an algorithm is left as an exercise to the reader.



[HTMLTimeElement/dateTime](#)

Support in all current engines.

Firefox 22+ Safari 10+ Chrome 62+

Opera 49+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 22+ Safari iOS 10+ Chrome Android 62+ WebView Android 62+ Samsung Internet 8.0+ Opera Android 46+

The **dateTime** IDL attribute must [reflect](#) the element's [datatype](#) content attribute.

The [time](#) element can be used to encode dates, for example in microformats. The following shows a hypothetical way of encoding an event using a variant on hCalendar that uses the [time](#) element:

```
<div class="vevent">
  <a class="url" href="http://www.web2con.com/">http://www.web2con.com/</a>
  <span class="summary">Web 2.0 Conference</span>:
  <time class="dtstart" datetime="2005-10-05">October 5</time> -
  <time class="dtend" datetime="2005-10-07">7</time>,
  at the <span class="location">Argent Hotel, San Francisco, CA</span>
</div>
```

Here, a fictional microdata vocabulary based on the Atom vocabulary is used with the [time](#) element to mark up a blog post's publication date.

```
<article itemscope itemtype="https://n.example.org/rfc4287">
  <h1 itemprop="title">Big tasks</h1>
  <footer>Published <time itemprop="published" datetime="2009-08-29">two days
    <p itemprop="content">Today, I went out and bought a bike for my kid.</p>
  </footer>
</article>
```

In this example, another article's publication date is marked up using [time](#), this time using the schema.org microdata vocabulary:

```
<article itemscope itemtype="http://schema.org/BlogPosting">
  <h1 itemprop="headline">Small tasks</h1>
  <footer>Published <time itemprop="datePublished" datetime="2009-08-30">yester
  <p itemprop="articleBody">I put a bike bell on her bike.</p>
</article>
```

In the following snippet, the [time](#) element is used to encode a date in the ISO8601 format, for later processing by a script:

```
<p>Our first date was <time datetime="2006-09-23">a Saturday</time>.</p>
```

In this second snippet, the value includes a time:

```
<p>We stopped talking at <time datetime="2006-09-24T05:00-07:00">5am the next
```

A script loaded by the page (and thus privy to the page's internal convention of marking up dates and times using the [time](#) element) could scan through the page and look at all the [time](#) elements therein to create an index of dates and times.

For example, this element conveys the string "Friday" with the additional semantic that the 18th of November 2011 is the meaning that corresponds to "Friday":

Today is <time datetime="2011-11-18">Friday</time>.

In this example, a specific time in the Pacific Standard Time timezone is specified:

Your next meeting is at <time datetime="2011-11-18T15:00-08:00">3pm</time>.

4.5.15 The **code** element



[Element/code](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

Uses [HTMLElement](#).

The `code` element [represents](#) a fragment of computer code. This could be an XML element name, a filename, a computer program, or any other string that a computer would recognize.

There is no formal way to indicate the language of computer code being marked up. Authors who wish to mark `code` elements with the language used, e.g. so that syntax highlighting scripts can use the right rules, can use the `class` attribute, e.g. by adding a class prefixed with "language-" to the element.

The following example shows how the element can be used in a paragraph to mark up element names and computer code, including punctuation.

```
<p>The <code>code</code> element represents a fragment of computer code.</p>
```

```
<p>When you call the <code>activate()</code> method on the <code>robotSnowman</code> object, the eyes glow.</p>
```

```
<p>The example below uses the <code>begin</code> keyword to indicate the start of a statement block. It is paired with an <code>end</code> keyword, which is followed by the <code>.;</code> punctuation character (full stop) to indicate the end of the program.</p>
```

The following example shows how a block of code could be marked up using the `pre` and `code` elements.

```
<pre><code class="language-pascal">var i: Integer;
begin
  i := 1;
```

```
end.</code></pre>
```

A class is used in that example to indicate the language used.

See the [pre](#) element for more details.

4.5.16 The **var** element



[Element/var](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [var](#) element [represents](#) a variable. This could be an actual variable in a mathematical expression or programming context, an identifier representing a constant, a symbol identifying

a physical quantity, a function parameter, or just be a term used as a placeholder in prose.

In the paragraph below, the letter "n" is being used as a variable in prose:

```
<p>If there are <var>n</var> pipes leading to the ice  
cream factory then I expect at least <em>least</em> <var>n</var>  
flavors of ice cream to be available for purchase!</p>
```

For mathematics, in particular for anything beyond the simplest of expressions, MathML is more appropriate. However, the [var](#) element can still be used to refer to specific variables that are then mentioned in MathML expressions.

In this example, an equation is shown, with a legend that references the variables in the equation. The expression itself is marked up with MathML, but the variables are mentioned in the figure's legend using [var](#).

```
<figure>  
  <math>  
    <mi>a</mi>  
    <mo>=</mo>  
    <msqrt>  
      <msup><mi>b</mi><mn>2</mn></msup>  
      <mi>+</mi>  
      <msup><mi>c</mi><mn>2</mn></msup>  
    </msqrt>  
  </math>  
  <figcaption>  
    Using Pythagoras' theorem to solve for the hypotenuse <var>a</var> of  
    a triangle with sides <var>b</var> and <var>c</var>  
  </figcaption>  
</figure>
```

Here, the equation describing mass-energy equivalence is used in a sentence, and the [var](#) element is used to mark the variables and constants in that equation:

```
<p>Then she turned to the blackboard and picked up the chalk. After a few moments  
thought, she wrote <var>E</var> = <var>m</var> <var>c</var><sup>2</sup>. The teacher  
looked pleased.</p>
```

4.5.17 The **samp** element



[Element/samp](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

Uses [HTMLElement](#).

The [`samp`](#) element [represents](#) sample or quoted output from another program or computing system.

See the [`pre`](#) and [`kbd`](#) elements for more details.

This element can be contrasted with the [`output`](#) element, which can be used to provide immediate output in a web application.

This example shows the [`samp`](#) element being used inline:

```
<p>The computer said <samp>Too much cheese in tray  
two</samp> but I didn't know what that meant.</p>
```

This second example shows a block of sample output from a console program. Nested [`samp`](#) and [`kbd`](#) elements allow for the styling of specific elements of the sample output using a style sheet. There's also a few parts of the [`samp`](#) that are annotated with even more detailed markup, to

enable very precise styling. To achieve this, `span` elements are used.

```
<pre><samp><span class="prompt">jdoe@mowmow:~$</span> <kbd>ssh demo.example.co  
Last login: Tue Apr 12 09:10:17 2005 from mowmow.example.com on pts/1  
Linux demo 2.6.10-grsec+gg3+e+fhs6b+nfs+gr0501+++p3+c4a+gr2b- reslog-v6.189 #1
```

```
<span class="prompt">jdoe@demo:~$</span> <span class="cursor">_</span></samp>
```

This third example shows a block of input and its respective output. The example uses both `code` and `samp` elements.

```
<pre>  
<code class="language-javascript">console.log(2.3 + 2.4)</code>  
<samp>4.69999999999999</samp>  
</pre>
```

4.5.18 The **kbd** element



[Element/kbd](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Categories:](#)

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The **kbd** element [represents](#) user input (typically keyboard input, although it may also be used to represent other input, such as voice commands).

When the **kbd** element is nested inside a **samp** element, it represents the input as it was echoed by the system.

When the **kbd** element *contains* a **samp** element, it represents input based on system output, for example invoking a menu item.

When the **kbd** element is nested inside another **kbd** element, it represents an actual key or other single unit of input as appropriate for the input mechanism.

Here the **kbd** element is used to indicate keys to press:

```
<p>To make George eat an apple, press <kbd><kbd>Shift</kbd>+<kbd>F3</kbd></kb
```

In this second example, the user is told to pick a particular menu item. The outer **kbd** element marks up a block of input, with the inner **kbd** elements representing each individual step of the input, and the **samp** elements inside them indicating that the steps are input based on something being displayed by the system, in this case menu labels:

```
<p>To make George eat an apple, select
```

```
  <kbd><kbd><samp>File</samp></kbd>|<kbd><samp>Eat Apple...</samp></kbd></k
```

Such precision isn't necessary; the following is equally fine:

```
<p>To make George eat an apple, select <kbd>File | Eat Apple...</kbd></p>
```

4.5.19 The **sub** and **sup** elements



[Element/sub](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Element/sup

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

The [sub](#) element: [for authors](#); [for implementers](#).

The [sup](#) element: [for authors](#); [for implementers](#).

DOM interface:

Use [HTMLElement](#).

The [sup](#) element [represents](#) a superscript and the [sub](#) element [represents](#) a subscript.

These elements must be used only to mark up typographical conventions with specific meanings, not for typographical presentation for presentation's sake. For example, it would be inappropriate for the [sub](#) and [sup](#) elements to be used in the name of the LaTeX document preparation system. In general, authors should use these elements only if the *absence* of those elements would change the meaning of the content.

In certain languages, superscripts are part of the typographical conventions for some abbreviations.

```
<p>Their names are  
<span lang="fr"><abbr>Mlle</abbr> Gwendoline</span> and  
<span lang="fr"><abbr>Mme</abbr> Denise</span>.</p>
```

The [sub](#) element can be used inside a [var](#) element, for variables that have subscripts.

Here, the [sub](#) element is used to represent the subscript that identifies the variable in a family of variables:

```
<p>The coordinate of the <var>i</var>th point is  
(<var>x<sub><var>i</var></sub></var>, <var>y<sub><var>i</var></sub></var>).  
For example, the 10th point has coordinate  
(<var>x<sub>10</sub></var>, <var>y<sub>10</sub></var>).</p>
```

Mathematical expressions often use subscripts and superscripts. Authors are encouraged to use MathML for marking up mathematics, but authors may opt to use [sub](#) and [sup](#) if detailed mathematical markup is not desired. [\[MATHML\]](#)

```
<var>E</var>=<var>m</var><var>c</var><sup>2</sup>
```

```
f(<var>x</var>, <var>n</var>) = log<sub>4</sub><var>x</var><sup><var>n</var></sup>
```

4.5.20 The *i* element



[Element/i](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [**i**](#) element [represents](#) a span of text in an alternate voice or mood, or otherwise offset from the normal prose in a manner indicating a different quality of text, such as a taxonomic designation, a technical term, an idiomatic phrase from another language, transliteration, a thought, or a ship name in Western texts.

Terms in languages different from the main text should be annotated with [**lang**](#) attributes (or, in XML, [lang attributes in the XML namespace](#)).

The examples below show uses of the [**i**](#) element:

```
<p>The <i class="taxonomy">Felis silvestris catus</i> is cute.</p>
<p>The term <i>prose content</i> is defined above.</p>
<p>There is a certain <i lang="fr">je ne sais quoi</i> in the air.</p>
```

In the following example, a dream sequence is marked up using [**i**](#) elements.

```
<p>Raymond tried to sleep.</p>
<p><i>The ship sailed away on Thursday</i>, he
dreamt. <i>The ship had many people aboard, including a beautiful
princess called Carey. He watched her, day-in, day-out, hoping she
would notice him, but she never did.</i></p>
<p><i>Finally one night he picked up the courage to speak with
her--</i></p>
<p>Raymond woke with a start as the fire alarm rang out.</p>
```

Authors can use the [**class**](#) attribute on the [**i**](#) element to identify why the element is being used, so that if the style of a particular use (e.g. dream sequences as opposed to taxonomic terms) is to be changed at a later date, the author doesn't have to go through the entire document (or series of related documents) annotating each use.

Authors are encouraged to consider whether other elements might be more applicable than the

i element, for instance the [em](#) element for marking up stress emphasis, or the [dfn](#) element to mark up the defining instance of a term.

Style sheets can be used to format **i** elements, just like any other element can be restyled. Thus, it is not the case that content in **i** elements will necessarily be italicized.

4.5.21 The **b** element



[Element/b](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

Categories:

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

Content model:

[Phrasing content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

DOM interface:

Uses [HTMLElement](#).

The **b** element [represents](#) a span of text to which attention is being drawn for utilitarian

purposes without conveying any extra importance and with no implication of an alternate voice or mood, such as key words in a document abstract, product names in a review, actionable words in interactive text-driven software, or an article lede.

The following example shows a use of the **b** element to highlight key words without marking them up as important:

```
<p>The <b>frobonitor</b> and <b>barbinator</b> components are fried.</p>
```

In the following example, objects in a text adventure are highlighted as being special by use of the **b** element.

```
<p>You enter a small room. Your <b>sword</b> glows  
brighter. A <b>rat</b> scurries past the corner wall.</p>
```

Another case where the **b** element is appropriate is in marking up the lede (or lead) sentence or paragraph. The following example shows how a [BBC article about kittens adopting a rabbit as their own](#) could be marked up:

```
<article>  
  <h2>Kittens 'adopted' by pet rabbit</h2>  
  <p><b class="lede">Six abandoned kittens have found an  
  unexpected new mother figure – a pet rabbit.</b></p>  
  <p>Veterinary nurse Melanie Humble took the three-week-old  
  kittens to her Aberdeen home.</p>  
  [...]
```

As with the **i** element, authors can use the **class** attribute on the **b** element to identify why the element is being used, so that if the style of a particular use is to be changed at a later date, the author doesn't have to go through annotating each use.

The **b** element should be used as a last resort when no other element is more appropriate. In particular, headings should use the **h1** to **h6** elements, stress emphasis should use the **em** element, importance should be denoted with the **strong** element, and text marked or highlighted should use the **mark** element.

The following would be *incorrect* usage:

```
<p><b>WARNING!</b> Do not frob the barbinator!</p>
```

In the previous example, the correct element to use would have been **strong**, not **b**.

Style sheets can be used to format **b** elements, just like any other element can be restyled. Thus, it is not the case that content in **b** elements will necessarily be boldened.

4.5.22 The ***u*** element

✓MDN

Element/u

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

Uses [HTMLElement](#).

The ***u*** element [represents](#) a span of text with an unarticulated, though explicitly rendered, non-textual annotation, such as labeling the text as being a proper name in Chinese text (a Chinese proper name mark), or labeling the text as being misspelt.

In most cases, another element is likely to be more appropriate: for marking stress emphasis, the ***em*** element should be used; for marking key words or phrases either the ***b*** element or the ***mark*** element should be used, depending on the context; for marking book titles, the ***cite*** element should be used; for labeling text with explicit textual annotations, the ***ruby*** element

should be used; for technical terms, taxonomic designation, transliteration, a thought, or for labeling ship names in Western texts, the [i](#) element should be used.

The default rendering of the [u](#) element in visual presentations clashes with the conventional rendering of hyperlinks (underlining). Authors are encouraged to avoid using the [u](#) element where it could be confused for a hyperlink.

In this example, a [u](#) element is used to mark a word as misspelt:

```
<p>The <u>see</u> is full of fish.</p>
```

4.5.23 The **mark** element



[Element/mark](#)

Support in all current engines.

Firefox 4+ Safari Yes Chrome Yes

Opera 11+ Edge Yes

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content.](#)

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The **mark** element [represents](#) a run of text in one document marked or highlighted for [reference](#) purposes, due to its relevance in another context. When used in a quotation or other block of text referred to from the prose, it indicates a highlight that was not originally present but which has been added to bring the reader's attention to a part of the text that might not have been considered important by the original author when the block was originally written, but which is now under previously unexpected scrutiny. When used in the main prose of a document, it indicates a part of the document that has been highlighted due to its likely relevance to the user's current activity.

This example shows how the **mark** element can be used to bring attention to a particular part of a quotation:

```
<p lang="en-US">Consider the following quote:</p>
<blockquote lang="en-GB">
  <p>Look around and you will find, no-one's really
    <mark>colour</mark> blind.</p>
</blockquote>
<p lang="en-US">As we can tell from the <em>spelling</em> of the word,
the person writing this quote is clearly not American.</p>
```

(If the goal was to mark the element as misspelt, however, the **u** element, possibly with a class, would be more appropriate.)

Another example of the **mark** element is highlighting parts of a document that are matching some search string. If someone looked at a document, and the server knew that the user was searching for the word "kitten", then the server might return the document with one paragraph modified as follows:

```
<p>I also have some <mark>kitten</mark>s who are visiting me
these days. They're really cute. I think they like my garden! Maybe I
should adopt a <mark>kitten</mark>.</p>
```

In the following snippet, a paragraph of text refers to a specific part of a code fragment.

```
<p>The highlighted part below is where the error lies:</p>
<pre><code>var i: Integer;
begin
  i := <mark>1.1</mark>;
end.</code></pre>
```

This is separate from *syntax highlighting*, for which [span](#) is more appropriate. Combining both, one would get:

```
<p>The highlighted part below is where the error lies:</p>
```

```
<pre><code><span class=keyword>var</span> <span class=ident>i</span>: <span c
<span class=keyword>begin</span>
  <span class=ident>i</span> := <span class=literal><mark>1.1</mark></span>;
<span class=keyword>end</span>.</code></pre>
```

This is another example showing the use of [mark](#) to highlight a part of quoted text that was originally not emphasized. In this example, common typographic conventions have led the author to explicitly style [mark](#) elements in quotes to render in italics.

```
<style>
  blockquote mark, q mark {
    font: inherit; font-style: italic;
    text-decoration: none;
    background: transparent; color: inherit;
  }
  .bubble em {
    font: inherit; font-size: larger;
    text-decoration: underline;
  }
</style>
<article>
  <h1>She knew</h1>
  <p>Did you notice the subtle joke in the joke on panel 4?</p>
  <blockquote>
    <p class="bubble">I didn't <em>want</em> to believe. <mark>Of course
      on some level I realized it was a known-plaintext attack.</mark> But I
      couldn't admit it until I saw for myself.</p>
  </blockquote>
  <p>(Emphasis mine.) I thought that was great. It's so pedantic, yet it
    explains everything neatly.</p>
</article>
```

Note, incidentally, the distinction between the [em](#) element in this example, which is part of the original text being quoted, and the [mark](#) element, which is highlighting a part for comment.

The following example shows the difference between denoting the *importance* of a span of text ([strong](#)) as opposed to denoting the *relevance* of a span of text ([mark](#)). It is an extract from a textbook, where the extract has had the parts relevant to the exam highlighted. The safety warnings, important though they may be, are apparently not relevant to the exam.

<h3>Wormhole Physics Introduction</h3>

<p><mark>A wormhole in normal conditions can be held open for a maximum of just under 39 minutes.</mark> Conditions that can increase the time include a powerful energy source coupled to one or both of the gates connecting the wormhole, and a large gravity well (such as a black hole).</p>

<p><mark>Momentum is preserved across the wormhole. Electromagnetic radiation can travel in both directions through a wormhole, but matter cannot.</mark></p>

<p>When a wormhole is created, a vortex normally forms. Warning: The vortex caused by the wormhole opening will annihilate anything in its path. Vortexes can be avoided when using sufficiently advanced dialing technology.</p>

<p><mark>An obstruction in a gate will prevent it from accepting a wormhole connection.</mark></p>

4.5.24 The **bdi** element



[Element/bdi](#)

Support in all current engines.

Firefox 10+ Safari 6+ Chrome 16+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 10+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 14+

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Phrasing content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

Also, the [dir](#) global attribute has special semantics on this element.

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTML Element](#).

The **bdi** element represents a span of text that is to be isolated from its surroundings for the purposes of bidirectional text formatting. [BIDI]

The `dir` global attribute defaults to `auto` on this element (it never inherits from the parent element like with other elements).

This element has rendering requirements involving the bidirectional algorithm.

This element is especially useful when embedding user-generated content with an unknown directionality.

In this example, usernames are shown along with the number of posts that the user has submitted. If the `bdi` element were not used, the username of the Arabic user would end up confusing the text (the bidirectional algorithm would put the colon and the number "3" next to the word "User" rather than next to the word "posts").

- User jcranmer: 12 posts.
 - User hober: 5 posts.
 - User ایان: 3 posts.

When using the `bdi` element, the username acts as expected.

- User **jeranmer**: 12 posts.
 - User **hober**: 5 posts.
 - User ۳ ایان: 3 posts.

If the `bdi` element were to be replaced by a `b` element, the username would confuse the bidirectional algorithm and the third bullet would end up saying "User 3 :", followed by the Arabic name (right-to-left), followed by "posts" and a period.

4.5.25 The *bdo* element



Element/bdo

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Also, the [dir](#) global attribute has special semantics on this element.

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

Uses [HTMLElement](#).

The [bdo](#) element [represents](#) explicit text directionality formatting control for its children. It allows authors to override the Unicode bidirectional algorithm by explicitly specifying a direction override. [\[BIDI\]](#)

Authors must specify the [dir](#) attribute on this element, with the value [ltr](#) to specify a left-to-right override and with the value [rtl](#) to specify a right-to-left override. The [auto](#) value must not be specified.

This element [has rendering requirements involving the bidirectional algorithm.](#)

4.5.26 The ***span*** element

✓MDN

[Element/span](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLSpanElement](#)

Support in all current engines.

Firefox 1+ Safari 6+ Chrome 15+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 14+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLSpanElement : HTMLElement {
    [HTMLConstructor] constructor();
};
```

The [span](#) element doesn't mean anything on its own, but can be useful when used together with the [global attributes](#), e.g. [class](#), [lang](#), or [dir](#). It [represents](#) its children.

In this example, a code fragment is marked up using [span](#) elements and [class](#) attributes so that its keywords and identifiers can be color-coded from CSS:

```
<pre><code class="lang-c"><span class="keyword">for</span> (<span class="ident">i_t3</span> = (<span class="ident">i_t3</span> & 0xffff) <span class="ident">i_t6</span> = (((((<span class="ident">i_t3</span> >> 8) <span class="keyword">if</span> (<span class="ident">i_t6</span> == <span class="ident">i_t7</span>)) ? <span class="keyword">break</span>;</code></pre>
```

4.5.27 The **br** element



[Element/br](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes



[HTMLBRElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content](#).

[Phrasing content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Nothing.](#)

[Tag omission in text/html:](#)

No [end tag](#).

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLBRElement : HTMLElement {
  [HTMLConstructor] constructor();
  // also has obsolete members
};
```

The [br](#) element [represents](#) a line break.

While line breaks are usually represented in visual media by physically moving subsequent text to a new line, a style sheet or user agent would be equally justified in causing line breaks to be rendered in a different manner, for instance as green dots, or as extra spacing.

[br](#) elements must be used only for line breaks that are actually part of the content, as in poems or addresses.

The following example is correct usage of the [br](#) element:

```
<p>P. Sherman<br>
42 Wallaby Way<br>
Sydney</p>
```

[br](#) elements must not be used for separating thematic groups in a paragraph.

The following examples are non-conforming, as they abuse the [br](#) element:

```
<p><a ...>34 comments.</a><br>
<a ...>Add a comment.</a></p>
```

```
<p><label>Name: <input name="name"></label><br>
<label>Address: <input name="address"></label></p>
```

Here are alternatives to the above, which are correct:

```
<p><a ...>34 comments.</a></p>
<p><a ...>Add a comment.</a></p>
```

```
<p><label>Name: <input name="name"></label></p>
<p><label>Address: <input name="address"></label></p>
```

If a [paragraph](#) consists of nothing but a single [**br**](#) element, it represents a placeholder blank line (e.g. as in a template). Such blank lines must not be used for presentation purposes.

Any content inside [**br**](#) elements must not be considered part of the surrounding text.

This element [has rendering requirements involving the bidirectional algorithm](#).

4.5.28 The **wbr** element



[Element/wbr](#)

Support in all current engines.

Firefox 1+ Safari 4+ Chrome 1+

Opera 11.6+ Edge 79+

Edge (Legacy) No Internet Explorer 5.5–7

Firefox Android 4+ Safari iOS? Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android?

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Nothing](#).

[Tag omission in text/html:](#)

No [end tag](#).

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

Uses [HTMLElement](#).

The [wbr](#) element [represents](#) a line break opportunity.

In the following example, someone is quoted as saying something which, for effect, is written as one long word. However, to ensure that the text can be wrapped in a readable fashion, the individual words in the quote are separated using a [wbr](#) element.

```
<p>So then she pointed at the tiger and screamed  
"there<wbr>is<wbr>no<wbr>way<wbr>you<wbr>are<wbr>ever<wbr>going<wbr>to<wbr>ca
```

Any content inside [wbr](#) elements must not be considered part of the surrounding text.

```
var wbr = document.createElement("wbr");  
wbr.textContent = "This is wrong";  
document.body.appendChild(wbr);
```

This element [has rendering requirements involving the bidirectional algorithm.](#)

4.5.29 Usage summary

This section is non-normative.

Element Purpose

[a](#) Hyperlinks Visit my [drinks](drinks.html) page.

[em](#) Stress
emphasis I must say I **adore** lemonade.

[strong](#) Importance This tea is **very hot**.

[small](#) Side
comments These grapes are made into wine. **Alcohol is addictive**

[s](#) Inaccurate
text Price: ~~£4.50~~ £2.00!

Element	Purpose	
<u>cite</u>	Titles of works	The case <cite>Hugo v. Danielle</cite> is relevant here.
<u>q</u>	Quotations	The judge said <q>You can drink water from the fish tank</q>
<u>dfn</u>	Defining instance	The term <dfn>organic food</dfn> refers to food produced with
<u>abbr</u>	Abbreviations	Organic food in Ireland is certified by the <abbr title="Irish Organic Standard">IOS</abbr>
<u>ruby</u> , <u>rt</u> , <u>rp</u>	Ruby annotations	<ruby> 0J <rp>(<rt>Orange Juice</rt>)</rp></ruby>
<u>data</u>	Machine-readable equivalent	Available starting today! <data value="UPC:022014640201">Normal price</data>
<u>time</u>	Machine-readable date- or time-related data	Available starting on <time datetime="2011-11-18">November 18, 2011</time>
<u>code</u>	Computer code	The <code>fruitdb</code> program can be used for tracking fruit.
<u>var</u>	Variables	If there are <var>n</var> fruit in the bowl, at least <var>n</var> are ripe.
<u>samp</u>	Computer output	The computer said <samp>Unknown error -3</samp> .
<u>kbd</u>	User input	Hit <kbd>F1</kbd> to continue.
<u>sub</u>	Subscripts	Water is H <sub>2</sub> 0.
<u>sup</u>	Superscripts	The Hydrogen in heavy water is usually <sup>2</sup>H .
<u>i</u>	Alternative voice	Lemonade consists primarily of <i>Citrus limon</i> .

Element	Purpose	
b	Keywords	Take a lemon and squeeze it with a juicer .
<u>u</u>	Annotations	The mixture of apple juice and <u class="spelling">eldeflowe</u>
<u>mark</u>	Highlight	Elderflower cordial, with one <mark>part</mark> cordial to t
<u>bdi</u>	Text directionality	The recommended restaurant is <bdi >my="" (at="" bdi="" café="" isolation<="" juice="" lang=""></bdi>
<u>bdo</u>	Text directionality	The proposal is to write English, but in reverse order. "Juice" formatting
<u>span</u>	Other	In French we call it sirop de sureau .
<u>br</u>	Line break	Simply Orange Juice Company Apopka, FL 32703 U.S.A.
<u>wbr</u>	Line breaking opportunity	www.simply<wbr>orange<wbr>juice.com

4.6 Links

4.6.1 Introduction

Links are a conceptual construct, created by [a](#), [area](#), [form](#), and [link](#) elements, that [represent](#) a connection between two resources, one of which is the current [Document](#). There are two kinds of links in HTML:

Links to external resources

These are links to resources that are to be used to augment the current document, generally automatically processed by the user agent. All [external resource links](#) have a [fetch and process the linked resource](#) algorithm which describes how the resource is obtained.

Hyperlinks

These are links to other resources that are generally exposed to the user by the user agent so that the user can cause the user agent to [navigate](#) to those resources, e.g. to visit them in a browser or download them.

For [link](#) elements with an [href](#) attribute and a [rel](#) attribute, links must be created for the

keywords of the [rel](#) attribute, as defined for those keywords in the [link types](#) section.

Similarly, for [a](#) and [area](#) elements with an [href](#) attribute and a [rel](#) attribute, links must be created for the keywords of the [rel](#) attribute as defined for those keywords in the [link types](#) section. Unlike [link](#) elements, however, [a](#) and [area](#) elements with an [href](#) attribute that either do not have a [rel](#) attribute, or whose [rel](#) attribute has no keywords that are defined as specifying [hyperlinks](#), must also create a [hyperlink](#). This implied hyperlink has no special meaning (it has no [link type](#)) beyond linking the element's [node document](#) to the resource given by the element's [href](#) attribute.

Similarly, for [form](#) elements with a [rel](#) attribute, links must be created for the keywords of the [rel](#) attribute as defined for those keywords in the [link types](#) section. [form](#) elements that do not have a [rel](#) attribute, or whose [rel](#) attribute has no keywords that are defined as specifying [hyperlinks](#), must also create a [hyperlink](#).

A [hyperlink](#) can have one or more *hyperlink annotations* that modify the processing semantics of that hyperlink.

4.6.2 Links created by [a](#) and [area](#) elements

The [href](#) attribute on [a](#) and [area](#) elements must have a value that is a [valid URL potentially surrounded by spaces](#).

The [href](#) attribute on [a](#) and [area](#) elements is not required; when those elements do not have [href](#) attributes they do not create hyperlinks.

The [target](#) attribute, if present, must be a [valid browsing context name or keyword](#). It gives the name of the [browsing context](#) that will be used. User agents use this name when [following hyperlinks](#).

When an [a](#) or [area](#) element's [activation behavior](#) is invoked, the user agent may allow the user to indicate a preference regarding whether the hyperlink is to be used for [navigation](#) or whether the resource it specifies is to be downloaded.

In the absence of a user preference, the default should be navigation if the element has no [download](#) attribute, and should be to download the specified resource if it does.

Whether determined by the user's preferences or via the presence or absence of the attribute, if the decision is to use the hyperlink for [navigation](#) then the user agent must [follow the hyperlink](#), and if the decision is to use the hyperlink to download a resource, the user agent must [download the hyperlink](#). These terms are defined in subsequent sections below.

The [download](#) attribute, if present, indicates that the author intends the hyperlink to be used for [downloading a resource](#). The attribute may have a value; the value, if any, specifies the default filename that the author recommends for use in labeling the resource in a local file system. There are no restrictions on allowed values, but authors are cautioned that most file systems have limitations with regard to what punctuation is supported in filenames, and user

agents are likely to adjust filenames accordingly.



[Element/a#attr-ping](#)

Support in all current engines.

Firefox Yes Safari 6+ Chrome 12+

Opera 15+ Edge 79+

Edge (Legacy) 17+ Internet Explorer No

Firefox Android No Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 14+

The ***ping*** attribute, if present, gives the URLs of the resources that are interested in being notified if the user follows the hyperlink. The value must be a [set of space-separated tokens](#), each of which must be a [valid non-empty URL](#) whose [scheme](#) is an [HTTP\(S\) scheme](#). The value is used by the user agent for [hyperlink auditing](#).

The ***rel*** attribute on [a](#) and [area](#) elements controls what kinds of links the elements create. The attribute's value must be an [unordered set of unique space-separated tokens](#). The [allowed keywords and their meanings](#) are defined below.

[rel's supported tokens](#) are the keywords defined in [HTML link types](#) which are allowed on [a](#) and [area](#) elements, impact the processing model, and are supported by the user agent. The possible [supported tokens](#) are [noreferrer](#), [noopener](#), and [opener](#). [rel's supported tokens](#) must only include the tokens from this list that the user agent implements the processing model for.

The ***rel*** attribute has no default value. If the attribute is omitted or if none of the values in the attribute are recognized by the user agent, then the document has no particular relationship with the destination resource other than there being a hyperlink between the two.

The ***hreflang*** attribute on [a](#) elements that create [hyperlinks](#), if present, gives the language of the linked resource. It is purely advisory. The value must be a valid BCP 47 language tag.

[\[BCP47\]](#) User agents must not consider this attribute authoritative — upon fetching the resource, user agents must use only language information associated with the resource to determine its language, not metadata included in the link to the resource.

The ***type*** attribute, if present, gives the [MIME type](#) of the linked resource. It is purely advisory. The value must be a [valid MIME type string](#). User agents must not consider the ***type*** attribute authoritative — upon fetching the resource, user agents must not use metadata included in the link to the resource to determine its type.

The ***referrerpolicy*** attribute is a [referrer policy attribute](#). Its purpose is to set the [referrer policy](#) used when [following hyperlinks](#). [\[REFERRERPOLICY\]](#)

4.6.3 API for [a](#) and [area](#) elements

```
interface mixin HTMLHyperlinkElementUtils {  
  [CEReactions] stringifier attribute USVString href;  
  readonly attribute USVString origin;  
  [CEReactions] attribute USVString protocol;  
  [CEReactions] attribute USVString username;  
  [CEReactions] attribute USVString password;  
  [CEReactions] attribute USVString host;  
  [CEReactions] attribute USVString hostname;  
  [CEReactions] attribute USVString port;  
  [CEReactions] attribute USVString pathname;  
  [CEReactions] attribute USVString search;  
  [CEReactions] attribute USVString hash;  
};
```

[hyperlink.toString\(\)](#)

[hyperlink.href](#)

✓MDN

[HTMLAnchorElement/href](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

[HTMLAnchorElement/toString](#)

Support in all current engines.

Firefox22+Safari4+Chrome52+

OperaYesEdge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android22+Safari iOS3+Chrome Android52+WebView Android52+Samsung

Internet6.0+Opera AndroidYes

[HTMLAreaElement/href](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

[HTMLAreaElement/toString](#)

Support in all current engines.

Firefox22+Safari4+Chrome52+

OperaYesEdge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android22+Safari iOS3+Chrome Android52+WebView Android52+Samsung Internet6.0+Opera AndroidYes

Returns the hyperlink's URL.

Can be set, to change the URL.

hyperlink.origin

✓MDN

[HTMLAnchorElement/origin](#)

Support in all current engines.

Firefox26+Safari5.1+Chrome8+

Opera15+Edge79+

Edge (Legacy)17+Internet ExplorerNo

Firefox Android26+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android14+

[HTMLAreaElement/origin](#)

Support in all current engines.

Firefox26+Safari5.1+Chrome8+

Opera15+Edge79+

Edge (Legacy)17+Internet ExplorerNo

Firefox Android26+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android14+

Returns the hyperlink's URL's origin.

hyperlink.protocol

✓MDN

[HTMLAnchorElement/protocol](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

[HTMLAreaElement/protocol](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

Returns the hyperlink's URL's scheme.

Can be set, to change the URL's scheme.

[*hyperlink.username*](#)

✓MDN

[HTMLAnchorElement/username](#)

Support in all current engines.

Firefox26+Safari10+Chrome32+

Opera19+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android26+Safari iOS10+Chrome Android32+WebView Android4.4.3+Samsung Internet2.0+Opera Android19+

[HTMLAreaElement/username](#)

Support in all current engines.

Firefox26+Safari10+Chrome32+

Opera19+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android26+Safari iOS10+Chrome Android32+WebView Android4.4.3+Samsung Internet2.0+Opera Android19+

Returns the hyperlink's URL's username.

Can be set, to change the URL's username.

[*hyperlink.password*](#)

✓MDN

[HTMLAnchorElement/password](#)

Support in all current engines.

Firefox26+Safari10+Chrome32+

Opera19+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android26+Safari iOS10+Chrome Android32+WebView Android4.4.3+Samsung Internet2.0+Opera Android19+

[HTMLAreaElement/password](#)

Support in all current engines.

Firefox26+Safari10+Chrome32+

Opera19+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android26+Safari iOS10+Chrome Android32+WebView Android4.4.3+Samsung Internet2.0+Opera Android19+

Returns the hyperlink's URL's password.

Can be set, to change the URL's password.

[*hyperlink.host*](#)

✓MDN

[HTMLAnchorElement/host](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera15+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android14+

[HTMLAreaElement/host](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera15+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android14+

Returns the hyperlink's URL's host and port (if different from the default port for the scheme).

Can be set, to change the URL's host and port.

[*hyperlink.hostname*](#)

✓MDN

[HTMLAnchorElement/hostname](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera15+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android14+

[HTMLAreaElement/hostname](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera15+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android14+

Returns the hyperlink's URL's host.

Can be set, to change the URL's host.

[hyperlink.port](#)

✓MDN

[HTMLAnchorElement/port](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera15+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android14+

[HTMLAreaElement/port](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera15+Edge79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android14+

Returns the hyperlink's URL's port.

Can be set, to change the URL's port.

[hyperlink.pathname](#)

✓MDN

[HTMLAnchorElement pathname](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

[HTMLAreaElement pathname](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

Returns the hyperlink's URL's path.

Can be set, to change the URL's path.

[*hyperlink*.search](#)

✓MDN

[HTMLAnchorElement/search](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

[HTMLAreaElement/search](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

Returns the hyperlink's URL's query (includes leading "?" if non-empty).

Can be set, to change the URL's query (ignores leading "?").

[*hyperlink*.hash](#)

✓MDN

[HTMLAnchorElement/hash](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

[HTMLAreaElement/hash](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy)12+Internet Explorer5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android14+

Returns the hyperlink's URL's fragment (includes leading "#" if non-empty).

Can be set, to change the URL's fragment (ignores leading "#").

An element implementing the [HTMLHyperlinkElementUtils](#) mixin has an associated *url* (null or a [URL](#)). It is initially null.

An element implementing the [HTMLHyperlinkElementUtils](#) mixin has an associated *set the url* algorithm, which runs these steps:

1. If this element's [href](#) content attribute is absent, set this element's [url](#) to null.
2. Otherwise, parse this element's [href](#) content attribute value relative to this element's [node document](#). If [parsing](#) is successful, set this element's [url](#) to the result; otherwise, set this element's [url](#) to null.

When elements implementing the [HTMLHyperlinkElementUtils](#) mixin are created, and whenever those elements have their [href](#) content attribute set, changed, or removed, the user agent must [set the url](#).

This is only observable for [blob:](#) URLs as [parsing](#) them involves a [Blob URL Store](#) lookup.

An element implementing the [HTMLHyperlinkElementUtils](#) mixin has an associated *reinitialize url* algorithm, which runs these steps:

1. If element's [url](#) is non-null, its [scheme](#) is "blob", and it has an [opaque path](#), then terminate these steps.
2. [Set the url](#).

To *update href*, set the element's [href](#) content attribute's value to the element's [url](#), [serialized](#).

The [href](#) getter steps are:

1. [Reinitialize url](#).
2. Let *url* be [this](#)'s [url](#).
3. If *url* is null and [this](#) has no [href](#) content attribute, return the empty string.
4. Otherwise, if *url* is null, return [this](#)'s [href](#) content attribute's value.

5. Return *url*, [serialized](#).

The [href](#) setter steps are to set [*this*](#)'s [href](#) content attribute's value to the given value.

The *origin* getter steps are:

1. [Reinitialize url](#).
2. If [*this*](#)'s [url](#) is null, return the empty string.
3. Return the [serialization](#) of [*this*](#)'s [url](#)'s *origin*.

The *protocol* getter steps are:

1. [Reinitialize url](#).
2. If [*this*](#)'s [url](#) is null, return ":".
3. Return [*this*](#)'s [url](#)'s [scheme](#), followed by ":".

The [protocol](#) setter steps are:

1. [Reinitialize url](#).
2. If [*this*](#)'s [url](#) is null, then return.
3. [Basic URL parse](#) the given value, followed by ":", with [*this*](#)'s [url](#) as *url* and [scheme start state](#) as [state override](#).

Because the URL parser ignores multiple consecutive colons, providing a value of "[https](#):" (or even "[https](#):::") is the same as providing a value of "[https](#)".

4. [Update href](#).

The *username* getter steps are:

1. [Reinitialize url](#).
2. If [*this*](#)'s [url](#) is null, return the empty string.
3. Return [*this*](#)'s [url](#)'s [username](#).

The [username](#) setter steps are:

1. [Reinitialize url](#).
2. Let *url* be [*this*](#)'s [url](#).

3. If *url* is null or *url* cannot have a username/password/port, then return.
4. Set the username, given *url* and the given value.
5. Update href.

The *password* getter steps are:

1. Reinitialize url.
2. Let *url* be *this*'s url.
3. If *url* is null, then return the empty string.
4. Return *url*'s password.

The password setter steps are:

1. Reinitialize url.
2. Let *url* be *this*'s url.
3. If *url* is null or *url* cannot have a username/password/port, then return.
4. Set the password, given *url* and the given value.
5. Update href.

The *host* getter steps are:

1. Reinitialize url.
2. Let *url* be *this*'s url.
3. If *url* or *url*'s host is null, return the empty string.
4. If *url*'s port is null, return *url*'s host, serialized.
5. Return *url*'s host, serialized, followed by ":" and *url*'s port, serialized.

The host setter steps are:

1. Reinitialize url.
2. Let *url* be *this*'s url.
3. If *url* is null or *url* has an opaque path, then return.

4. [Basic URL parse](#) the given value, with *url* as [url](#) and [host state](#) as [state override](#).
5. [Update href](#).

The [hostname](#) getter steps are:

1. [Reinitialize url](#).
2. Let *url* be [this's url](#).
3. If *url* or *url*'s [host](#) is null, return the empty string.
4. Return *url*'s [host, serialized](#).

The [hostname](#) setter steps are:

1. [Reinitialize url](#).
2. Let *url* be [this's url](#).
3. If *url* is null or *url* has an [opaque path](#), then return.
4. [Basic URL parse](#) the given value, with *url* as [url](#) and [hostname state](#) as [state override](#).
5. [Update href](#).

The [port](#) getter steps are:

1. [Reinitialize url](#).
2. Let *url* be [this's url](#).
3. If *url* or *url*'s [port](#) is null, return the empty string.
4. Return *url*'s [port, serialized](#).

The [port](#) setter steps are:

1. [Reinitialize url](#).
2. Let *url* be [this's url](#).
3. If *url* is null or *url* [cannot have a username/password/port](#), then return.
4. If the given value is the empty string, then set *url*'s [port](#) to null.
5. Otherwise, [basic URL parse](#) the given value, with *url* as [url](#) and [port state](#) as [state override](#).

6. [Update href](#).

The `pathname` getter steps are:

1. [Reinitialize url](#).
2. Let `url` be `this`'s [url](#).
3. If `url` is null, then return the empty string.
4. Return the result of [URL path serializing](#) `url`.

The `pathname` setter steps are:

1. [Reinitialize url](#).
2. Let `url` be `this`'s [url](#).
3. If `url` is null or `url` has an [opaque path](#), then return.
4. Set `url`'s [path](#) to the empty list.
5. [Basic URL parse](#) the given value, with `url` as [url](#) and [path start state](#) as [state override](#).
6. [Update href](#).

The `search` getter steps are:

1. [Reinitialize url](#).
2. Let `url` be `this`'s [url](#).
3. If `url` is null, or `url`'s [query](#) is either null or the empty string, return the empty string.
4. Return "?", followed by `url`'s [query](#).

The `search` setter steps are:

1. [Reinitialize url](#).
2. Let `url` be `this`'s [url](#).
3. If `url` is null, terminate these steps.
4. If the given value is the empty string, set `url`'s [query](#) to null.
5. Otherwise:

1. Let *input* be the given value with a single leading "?" removed, if any.
2. Set *url*'s [query](#) to the empty string.
3. [Basic URL parse](#) *input*, with null, this element's [node document](#)'s [document's character encoding](#), *url* as [url](#), and [query state](#) as [state override](#).
6. [Update href](#).

The [hash](#) getter steps are:

1. [Reinitialize url](#).
2. Let *url* be [this](#)'s [url](#).
3. If *url* is null, or *url*'s [fragment](#) is either null or the empty string, return the empty string.
4. Return "#", followed by *url*'s [fragment](#).

The [hash](#) setter steps are:

1. [Reinitialize url](#).
2. Let *url* be [this](#)'s [url](#).
3. If *url* is null, then return.
4. If the given value is the empty string, set *url*'s [fragment](#) to null.
5. Otherwise:
 1. Let *input* be the given value with a single leading "#" removed, if any.
 2. Set *url*'s [fragment](#) to the empty string.
 3. [Basic URL parse](#) *input*, with *url* as [url](#) and [fragment state](#) as [state override](#).
6. [Update href](#).

4.6.4 Following hyperlinks

An element *element* *cannot navigate* if one of the following is true:

- *element*'s [node document](#) is not [fully active](#)
- *element* is not an [a](#) element and is not [connected](#).

This is also used by [form submission](#) for the [form](#) element. The exception for [a](#) elements is for compatibility with web content.

To get an element's `noopener`, given an [a](#), [area](#), or [form](#) element `element` and a string `target`:

1. If `element`'s [link types](#) include the [noopener](#) or [noreferrer](#) keyword, then return true.
2. If `element`'s [link types](#) do not include the [opener](#) keyword and `target` is an [ASCII case-insensitive](#) match for "`_blank`", then return true.
3. Return false.

To follow the hyperlink created by an element `subject`, given an optional `hyperlinkSuffix` (default null):

1. If `subject` [cannot navigate](#), then return.
2. Let `replace` be false.
3. Let `source` be `subject`'s [node document](#)'s [browsing context](#).
4. Let `targetAttributeValue` be the empty string.
5. If `subject` is an [a](#) or [area](#) element, then set `targetAttributeValue` to the result of [getting an element's target](#) given `subject`.
6. Let `noopener` be the result of [getting an element's noopener](#) with `subject` and `targetAttributeValue`.
7. Let `target` and `windowType` be the result of applying [the rules for choosing a browsing context](#) given `targetAttributeValue`, `source`, and `noopener`.
8. If `target` is null, then return.
9. [Parse a URL](#) given `subject`'s [href](#) attribute, relative to `subject`'s [node document](#).
10. If that is successful, let `URL` be the [resulting URL string](#).

Otherwise, if [parsing](#) the [URL](#) failed, the user agent may report the error to the user in a user-agent-specific manner, may [queue an element task](#) on the [DOM manipulation task source](#) given `subject` to [navigate](#) the `target` [browsing context](#) to an error page to report the error, or may ignore the error and do nothing. In any case, the user agent must then return.

11. If `hyperlinkSuffix` is non-null, then append it to `URL`.
12. Let `request` be a new [request](#) whose [URL](#) is `URL` and whose [referrer policy](#) is the current state of `subject`'s [referrerpolicy](#) content attribute.
13. If `subject`'s [link types](#) includes the [noreferrer](#) keyword, then set `request`'s [referrer](#) to

"no-referrer".

14. Let *historyHandling* be "[replace](#)" if *windowType* is not "existing or none"; otherwise, "[default](#)".

Unlike many other types of navigations, following hyperlinks does not have special "[replace](#)" behavior for when documents are not [completely loaded](#). This is true for both user-initiated instances of following hyperlinks, as well as script-triggered ones via, e.g., `aElement.click()`.

15. [Queue an element task](#) on the [DOM manipulation task source](#) given *subject* to [navigate](#) *target* to [request](#) with [historyHandling](#) set to *historyHandling* and the [source browsing context](#) set to *source*.

4.6.5 Downloading resources



[HTMLAnchorElement/download](#)

Support in all current engines.

Firefox 20+ Safari 10.1+ Chrome 15+

Opera 15+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 20+ Safari iOS 10.3+ Chrome Android 18+ WebView Android <37+ Samsung Internet 1.0+ Opera Android 14+

In some cases, resources are intended for later use rather than immediate viewing. To indicate that a resource is intended to be downloaded for use later, rather than immediately used, the [download](#) attribute can be specified on the [a](#) or [area](#) element that creates the [hyperlink](#) to that resource.

The attribute can furthermore be given a value, to specify the filename that user agents are to use when storing the resource in a file system. This value can be overridden by the '[Content-Disposition](#)' HTTP header's filename parameters. [\[RFC6266\]](#)

In cross-origin situations, the [download](#) attribute has to be combined with the '[Content-Disposition](#)' HTTP header, specifically with the **attachment** disposition type, to avoid the user being warned of possibly nefarious activity. (This is to protect users from being made to download sensitive personal or confidential information without their full understanding.)

The following *allowed to download* algorithm takes an *initiator browsing context* and an *instantiator browsing context*, and returns a boolean indicating whether or not downloading is allowed:

1. If the *initiator browsing context*'s [sandboxing flags](#) has the [sandboxed downloads browsing context flag](#) set, then return false.
2. If the *instantiator browsing context* is non-null, and its [sandboxing flags](#) has the [sandboxed downloads browsing context flag](#) set, then return false.
3. Optionally, the user agent may return false, if it believes doing so would safeguard the user from a potentially hostile download.
4. Return true.

To *download the hyperlink* created by an element *subject*, given an optional *hyperlinkSuffix* (default null):

1. If *subject* [cannot navigate](#), then return.
2. Run the [allowed to download](#) algorithm with the *subject*'s [node document](#)'s [browsing context](#) and null. If the algorithm returns false, then return.
3. [Parse a URL](#) given *subject*'s [href](#) attribute, relative to *subject*'s [node document](#).
4. If [parsing the URL](#) fails, the user agent may report the error to the user in a user-agent-specific manner, may [navigate](#) to an error page to report the error, or may ignore the error and do nothing. In either case, the user agent must return.
5. Otherwise, let *URL* be the [resulting URL string](#).
6. If *hyperlinkSuffix* is non-null, then append it to *URL*.
7. Run these steps [in parallel](#):
 1. Let *request* be a new [request](#) whose [URL](#) is *URL*, [client](#) is [entry settings object](#), [initiator](#) is "download", [destination](#) is the empty string, and whose [synchronous flag](#) and [use-URL-credentials flag](#) are set.
 2. Handle the result of [fetching request as a download](#).

When a user agent is to handle a resource obtained from a fetch *as a download*, it should provide the user with a way to save the resource for later use, if a resource is successfully obtained. Otherwise, it should report any problems downloading the file to the user.

If the user agent needs a filename for a resource being handled [as a download](#), it should select one using the following algorithm.

This algorithm is intended to mitigate security dangers involved in downloading files from untrusted sites, and user agents are strongly urged to follow it.

1. Let *filename* be the undefined value.

2. If the resource has a '[Content-Disposition](#)' header, that header specifies the **attachment** disposition type, and the header includes filename information, then let *filename* have the value specified by the header, and jump to the step labeled *sanitize* below. [\[RFC6266\]](#)
3. Let *interface origin* be the [origin](#) of the [Document](#) in which the [download](#) or [navigate](#) action resulting in the download was initiated, if any.
4. Let *resource origin* be the [origin](#) of the URL of the resource being downloaded, unless that URL's [scheme](#) component is **data**, in which case let *resource origin* be the same as the *interface origin*, if any.
5. If there is no *interface origin*, then let *trusted operation* be true. Otherwise, let *trusted operation* be true if *resource origin* is the [same origin](#) as *interface origin*, and false otherwise.
6. If *trusted operation* is true and the resource has a '[Content-Disposition](#)' header and that header includes filename information, then let *filename* have the value specified by the header, and jump to the step labeled *sanitize* below. [\[RFC6266\]](#)
7. If the download was not initiated from a [hyperlink](#) created by an [a](#) or [area](#) element, or if the element of the [hyperlink](#) from which it was initiated did not have a [download](#) attribute when the download was initiated, or if there was such an attribute but its value when the download was initiated was the empty string, then jump to the step labeled *no proposed filename*.
8. Let *proposed filename* have the value of the [download](#) attribute of the element of the [hyperlink](#) that initiated the download at the time the download was initiated.
9. If *trusted operation* is true, let *filename* have the value of *proposed filename*, and jump to the step labeled *sanitize* below.
10. If the resource has a '[Content-Disposition](#)' header and that header specifies the **attachment** disposition type, let *filename* have the value of *proposed filename*, and jump to the step labeled *sanitize* below. [\[RFC6266\]](#)
11. *No proposed filename*: If *trusted operation* is true, or if the user indicated a preference for having the resource in question downloaded, let *filename* have a value derived from the [URL](#) of the resource in an [implementation-defined](#) manner, and jump to the step labeled *sanitize* below.
12. Let *filename* be set to the user's preferred filename or to a filename selected by the user agent, and jump to the step labeled *sanitize* below.

If the algorithm reaches this step, then a download was begun from a different origin than the resource being downloaded, and the origin did not mark the file as suitable for downloading, and the download was not initiated by the user. This could be because a

[download](#) attribute was used to trigger the download, or because the resource in question is not of a type that the user agent supports.

This could be dangerous, because, for instance, a hostile server could be trying to get a user to unknowingly download private information and then re-upload it to the hostile server, by tricking the user into thinking the data is from the hostile server.

Thus, it is in the user's interests that the user be somehow notified that the resource in question comes from quite a different source, and to prevent confusion, any suggested filename from the potentially hostile *interface origin* should be ignored.

13. *Sanitize*: Optionally, allow the user to influence *filename*. For example, a user agent could prompt the user for a filename, potentially providing the value of *filename* as determined above as a default value.
14. Adjust *filename* to be suitable for the local file system.

For example, this could involve removing characters that are not legal in filenames, or trimming leading and trailing whitespace.

15. If the platform conventions do not in any way use [extensions](#) to determine the types of file on the file system, then return *filename* as the filename.
16. Let *claimed type* be the type given by the resource's [Content-Type metadata](#), if any is known. Let *named type* be the type given by *filename*'s [extension](#), if any is known. For the purposes of this step, a *type* is a mapping of a [MIME type](#) to an [extension](#).
17. If *named type* is consistent with the user's preferences (e.g., because the value of *filename* was determined by prompting the user), then return *filename* as the filename.
18. If *claimed type* and *named type* are the same type (i.e., the type given by the resource's [Content-Type metadata](#) is consistent with the type given by *filename*'s [extension](#)), then return *filename* as the filename.
19. If the *claimed type* is known, then alter *filename* to add an [extension](#) corresponding to *claimed type*.

Otherwise, if *named type* is known to be potentially dangerous (e.g. it will be treated by the platform conventions as a native executable, shell script, HTML application, or executable-macro-capable document) then optionally alter *filename* to add a known-safe [extension](#) (e.g. ".txt").

This last step would make it impossible to download executables, which might not be desirable. As always, implementers are forced to balance security and usability in this matter.

20. Return *filename* as the filename.

For the purposes of this algorithm, a file *extension* consists of any part of the filename that platform conventions dictate will be used for identifying the type of the file. For example, many operating systems use the part of the filename following the last dot (" .") in the filename to determine the type of the file, and from that the manner in which the file is to be opened or executed.

User agents should ignore any directory or path information provided by the resource itself, its [URL](#), and any [download](#) attribute, in deciding where to store the resulting file in the user's file system.

4.6.6 *Hyperlink auditing*

If a [hyperlink](#) created by an [a](#) or [area](#) element has a [ping](#) attribute, and the user follows the hyperlink, and the value of the element's [href](#) attribute can be [parsed](#), relative to the element's [node document](#), without failure, then the user agent must take the [ping](#) attribute's value, [split that string on ASCII whitespace](#), [parse](#) each resulting token relative to the element's [node document](#), and then run these steps for each [resulting URL record](#) *ping URL*, ignoring tokens that fail to parse:

1. If *ping URL*'s [scheme](#) is not an [HTTP\(S\) scheme](#), then return.
2. Optionally, return. (For example, the user agent might wish to ignore any or all ping URLs in accordance with the user's expressed preferences.)
3. Let *request* be a new [request](#) whose [URL](#) is *ping URL*, [method](#) is '[POST](#)', [body](#) is '[PING](#)', [client](#) is the [environment settings object](#) of the [Document](#) containing the [hyperlink](#), [destination](#) is the empty string, [credentials mode](#) is "[include](#)", [referrer](#) is "[no-referrer](#)", and whose [use-URL-credentials flag](#) is set.
4. Let *target URL* be the [resulting URL string](#) obtained from [parsing](#) the value of the element's [href](#) attribute and then:

If the [URL](#) of the [Document](#) object containing the hyperlink being audited and *ping URL* have the [same origin](#)

If the origins are different, but the [scheme](#) of the [URL](#) of the [Document](#) containing the hyperlink being audited is not "[https](#)"

request must include a '[Ping-From](#)' header with, as its value, the [URL](#) of the document containing the hyperlink, and a '[Ping-To](#)' HTTP header with, as its value, the *target URL*.

Otherwise

request must include a '[Ping-To](#)' HTTP header with, as its value, *target URL*.
request does not include a '[Ping-From](#)' header.

5. [Fetch request](#).

This may be done [in parallel](#) with the primary fetch, and is independent of the result of that

fetch.

User agents should allow the user to adjust this behavior, for example in conjunction with a setting that disables the sending of HTTP '[Referer](#)' (sic) headers. Based on the user's preferences, UAs may either [ignore](#) the [ping](#) attribute altogether, or selectively ignore URLs in the list (e.g. ignoring any third-party URLs); this is explicitly accounted for in the steps above.

User agents must ignore any entity bodies returned in the responses. User agents may close the connection prematurely once they start receiving a response body.

When the [ping](#) attribute is present, user agents should clearly indicate to the user that following the hyperlink will also cause secondary requests to be sent in the background, possibly including listing the actual target URLs.

For example, a visual user agent could include the hostnames of the target ping URLs along with the hyperlink's actual URL in a status bar or tooltip.

The [ping](#) attribute is redundant with pre-existing technologies like HTTP redirects and JavaScript in allowing web pages to track which off-site links are most popular or allowing advertisers to track click-through rates.

However, the [ping](#) attribute provides these advantages to the user over those alternatives:

- It allows the user to see the final target URL unobscured.
- It allows the UA to inform the user about the out-of-band notifications.
- It allows the user to disable the notifications without losing the underlying link functionality.
- It allows the UA to optimize the use of available network bandwidth so that the target page loads faster.

Thus, while it is possible to track users without this feature, authors are encouraged to use the [ping](#) attribute so that the user agent can make the user experience more transparent.

4.6.6.1 The '[Ping-From](#)' and '[Ping-To](#)' headers

The '[Ping-From](#)' and '[Ping-To](#)' HTTP request headers are included in [hyperlink auditing](#) requests. Their value is a [URL](#), [serialized](#).

4.6.7 Link types



[Link_types](#)

Support in all current engines.

Firefox 1+ | Safari Yes | Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Link_types](#)

The following table summarizes the link types that are defined by this specification, by their corresponding keywords. This table is non-normative; the actual definitions for the link types are given in the next few sections.

In this section, the term *referenced document* refers to the resource identified by the element representing the link, and the term *current document* refers to the resource within which the element representing the link finds itself.

To determine which link types apply to a [link](#), [a](#), [area](#), or [form](#) element, the element's [rel](#) attribute must be [split on ASCII whitespace](#). The resulting tokens are the keywords for the link types that apply to that element.

Except where otherwise specified, a keyword must not be specified more than once per [rel](#) attribute.

Some of the sections that follow the table below list synonyms for certain keywords. The indicated synonyms are to be handled as specified by user agents, but must not be used in documents (for example, the keyword "[copyright](#)").

Keywords are always [ASCII case-insensitive](#), and must be compared as such.

Thus, `rel="next"` is the same as `rel="NEXT"`.

Keywords that are *body-ok* affect whether [link](#) elements are [allowed in the body](#). The *body-ok* keywords are [dns-prefetch](#), [modulepreload](#), [pingback](#), [preconnect](#), [prefetch](#), [preload](#), [prerender](#), and [stylesheet](#).

New link types that are to be implemented by web browsers are to be added to this standard. The remainder can be [registered as extensions](#).

Link type	Effect on...				Brief description
	link	a and area	form	body- ok	
alternate	Hyperlink		<i>not allowed</i>		Gives alternate representations of the current document.
canonical	Hyperlink	<i>not allowed</i>			Gives the preferred URL for the current document.
author	Hyperlink		<i>not allowed</i>		Gives a link to the author of the current document or article.

Link type	Effect on...				Brief description
	link	a and area	form	body-ok	
bookmark	<i>not allowed</i>	Hyperlink	<i>not allowed</i>	.	Gives the permalink for the nearest ancestor section.
dns-prefetch	External Resource		<i>not allowed</i>	Yes	Specifies that the user agent should preemptively perform DNS resolution for the target resource's origin .
external	<i>not allowed</i>	Annotation			Indicates that the referenced document is not part of the same site as the current document.
help	Hyperlink				Provides a link to context-sensitive help.
icon	External Resource		<i>not allowed</i>		Imports an icon to represent the current document.
manifest	External Resource		<i>not allowed</i>		Imports or links to an application manifest . [MANIFEST]
modulepreload	External Resource		<i>not allowed</i>	Yes	Specifies that the user agent must preemptively fetch the module script and store it in the document's module map for later evaluation. Optionally, the module's dependencies can be fetched as well.
license	Hyperlink				Indicates that the main content of the current document is covered by the copyright license described by the referenced document.
next	Hyperlink				Indicates that the current document is a part of a series, and that the next document in the series is the referenced document.
nofollow	<i>not allowed</i>	Annotation			Indicates that the current document's original author or publisher does not endorse the referenced document.
noopener	<i>not allowed</i>	Annotation			Creates a top-level browsing context that is not an auxiliary browsing context if the hyperlink would create either of those to begin with (i.e., has an appropriate target attribute value).
noreferrer	<i>not allowed</i>	Annotation			No ' Referer ' (sic) header will be included. Additionally, has the same effect as noopener .
opener	<i>not allowed</i>	Annotation			Creates an auxiliary browsing context if the hyperlink would otherwise create a top-level browsing context that is not an auxiliary browsing context (i.e., has " _blank " as target attribute value).

Link type		Effect on...			Brief description
	link	a and area	form	body-ok	
pingback	External Resource	<i>not allowed</i>		Yes	Gives the address of the pingback server that handles pingbacks to the current document.
preconnect	External Resource	<i>not allowed</i>		Yes	Specifies that the user agent should preemptively connect to the target resource's origin .
prefetch	External Resource	<i>not allowed</i>		Yes	Specifies that the user agent should preemptively fetch and cache the target resource as it is likely to be required for a followup navigation .
preload	External Resource	<i>not allowed</i>		Yes	Specifies that the user agent must preemptively fetch and cache the target resource for current navigation according to the potential destination given by the as attribute (and the priority associated with the corresponding destination).
prerender	External Resource	<i>not allowed</i>		Yes	Specifies that the user agent should preemptively fetch the target resource and process it in a way that helps deliver a faster response in the future.
prev	Hyperlink				Indicates that the current document is a part of a series, and that the previous document in the series is the referenced document.
search	Hyperlink				• Gives a link to a resource that can be used to search through the current document and its related pages.
stylesheet	External Resource	<i>not allowed</i>		Yes	Imports a style sheet.
tag	<i>not allowed</i>	Hyperlink	<i>not allowed</i>		• Gives a tag (identified by the given address) that applies to the current document.

4.6.7.1 Link type "**alternate**"

MDN

[Alternative_style_sheets](#)

Support in one engine only.

Firefox3+Safari?Chrome1–48

Opera Yes Edge No

Edge (Legacy)? Internet Explorer 8+

Firefox Android 4+ Safari iOS? Chrome Android? WebView Android? Samsung Internet? Opera Android?

The **alternate** keyword may be used with [link](#), [a](#), and [area](#) elements.

The meaning of this keyword depends on the values of the other attributes.

If the element is a [link](#) element and the **rel** attribute also contains the keyword [stylesheet](#)

The **alternate** keyword modifies the meaning of the [stylesheet](#) keyword in the way described for that keyword. The **alternate** keyword does not create a link of its own.

Here, a set of [link](#) elements provide some style sheets:

```
<!-- a persistent style sheet -->
<link rel="stylesheet" href="default.css">

<!-- the preferred alternate style sheet -->
<link rel="stylesheet" href="green.css" title="Green styles">

<!-- some alternate style sheets -->
<link rel="alternate stylesheet" href="contrast.css" title="High contrast">
<link rel="alternate stylesheet" href="big.css" title="Big fonts">
<link rel="alternate stylesheet" href="wide.css" title="Wide screen">
```

If the **alternate** keyword is used with the **type** attribute set to the value **application/rss+xml** or the value **application/atom+xml**

The keyword creates a [hyperlink](#) referencing a syndication feed (though not necessarily syndicating exactly the same content as the current page).

For the purposes of feed autodiscovery, user agents should consider all [link](#) elements in the document with the **alternate** keyword used and with their **type** attribute set to the value **application/rss+xml** or the value **application/atom+xml**. If the user agent has the concept of a default syndication feed, the first such element (in [tree order](#)) should be used as the default.

The following [link](#) elements give syndication feeds for a blog:

```
<link rel="alternate" type="application/atom+xml" href="posts.xml" title=">
<link rel="alternate" type="application/atom+xml" href="posts.xml?category=>
<link rel="alternate" type="application/atom+xml" href="comments.xml" titl>
```

Such [link](#) elements would be used by user agents engaged in feed autodiscovery, with the first being the default (where applicable).

The following example offers various different syndication feeds to the user, using [a](#) elements:

```
<p>You can access the planets database using Atom feeds:</p>
<ul>
  <li><a href="recently-visited-planets.xml" rel="alternate" type="application/atom+xml">Recently Visited Planets</a>
  <li><a href="known-bad-planets.xml" rel="alternate" type="application/atom+xml">Known Bad Planets</a>
  <li><a href="unexplored-planets.xml" rel="alternate" type="application/atom+xml">Unexplored Planets</a>
</ul>
```

These links would not be used in feed autodiscovery.

Otherwise

The keyword creates a [hyperlink](#) referencing an alternate representation of the current document.

The nature of the referenced document is given by the hreflang, and [type](#) attributes.

If the [alternate](#) keyword is used with the hreflang attribute, and that attribute's value differs from the [document element](#)'s [language](#), it indicates that the referenced document is a translation.

If the [alternate](#) keyword is used with the [type](#) attribute, it indicates that the referenced document is a reformulation of the current document in the specified format.

The hreflang and [type](#) attributes can be combined when specified with the [alternate](#) keyword.

The following example shows how you can specify versions of the page that use alternative formats, are aimed at other languages, and that are intended for other media:

```
<link rel=alternate href="/en/html" hreflang=en type=text/html title="English Version"
<link rel=alternate href="/fr/html" hreflang=fr type=text/html title="French Version"
<link rel=alternate href="/en/html/print" hreflang=en type=text/html media=print
<link rel=alternate href="/fr/html/print" hreflang=fr type=text/html media=print
<link rel=alternate href="/en/pdf" hreflang=en type=application/pdf title="English Version"
<link rel=alternate href="/fr/pdf" hreflang=fr type=application/pdf title="French Version"
```

This relationship is transitive — that is, if a document links to two other documents with the link type "[alternate](#)", then, in addition to implying that those documents are alternative representations of the first document, it is also implying that those two documents are alternative representations of each other.

4.6.7.2 Link type "**author**"

The [author](#) keyword may be used with [link](#), [a](#), and [area](#) elements. This keyword creates a

[hyperlink](#).

For [a](#) and [area](#) elements, the **author** keyword indicates that the referenced document provides further information about the author of the nearest [article](#) element ancestor of the element defining the hyperlink, if there is one, or of the page as a whole, otherwise.

For [link](#) elements, the **author** keyword indicates that the referenced document provides further information about the author for the page as a whole.

The "referenced document" can be, and often is, a [mailto:](#) URL giving the email address of the author. [\[MAILTO\]](#)

Synonyms: For historical reasons, user agents must also treat [link](#), [a](#), and [area](#) elements that have a **rev** attribute with the value "**made**" as having the **author** keyword specified as a link relationship.

4.6.7.3 Link type "**bookmark**"

The [bookmark](#) keyword may be used with [a](#) and [area](#) elements. This keyword creates a [hyperlink](#).

The [bookmark](#) keyword gives a permalink for the nearest ancestor [article](#) element of the linking element in question, or of [the section the linking element is most closely associated with](#), if there are no ancestor [article](#) elements.

The following snippet has three permalinks. A user agent could determine which permalink applies to which part of the spec by looking at where the permalinks are given.

```
...
<body>
  <h1>Example of permalinks</h1>
  <div id="a">
    <h2>First example</h2>
    <p><a href="a.html" rel="bookmark">This permalink applies to
       only the content from the first H2 to the second H2</a>. The DIV isn't
       exactly that section, but it roughly corresponds to it.</p>
  </div>
  <h2>Second example</h2>
  <article id="b">
    <p><a href="b.html" rel="bookmark">This permalink applies to
       the outer ARTICLE element</a> (which could be, e.g., a blog post).</p>
    <article id="c">
      <p><a href="c.html" rel="bookmark">This permalink applies to
         the inner ARTICLE element</a> (which could be, e.g., a blog comment).</p>
    </article>
  </article>
</body>
```

...

4.6.7.4 Link type "**canonical**"

The [canonical](#) keyword may be used with [link](#) element. This keyword creates a [hyperlink](#).

The [canonical](#) keyword indicates that URL given by the [href](#) attribute is the preferred URL for the current document. That helps search engines reduce duplicate content, as described in more detail in *The Canonical Link Relation*. [\[RFC6596\]](#)

4.6.7.5 Link type "**dns-prefetch**"

MDN

[Link_types/dns-prefetch](#)

Firefox 3+ Safari ? Chrome 46+

Opera 33+ Edge 79+

Edge (Legacy) No Internet Explorer?

Firefox Android 4+ Safari iOS ? Chrome Android Yes WebView Android 46+ Samsung Internet Yes Opera Android ?

The [dns-prefetch](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#). This keyword is [body-ok](#).

The [dns-prefetch](#) keyword indicates that preemptively performing DNS resolution for the [origin](#) of the specified resource is likely to be beneficial, as it is highly likely that the user will require resources located at that [origin](#), and the user experience would be improved by preempting the latency costs associated with DNS resolution. User agents must implement the processing model of the [dns-prefetch](#) keyword described in *Resource Hints*.

[\[RESOURCEHINTS\]](#)

There is no default type for resources given by the [dns-prefetch](#) keyword.

4.6.7.6 Link type "**external**"

The [external](#) keyword may be used with [a](#), [area](#), and [form](#) elements. This keyword does not create a [hyperlink](#), but [annotates](#) any other hyperlinks created by the element (the implied hyperlink, if no other keywords create one).

The [external](#) keyword indicates that the link is leading to a document that is not part of the site that the current document forms a part of.

4.6.7.7 Link type "**help**"

The [help](#) keyword may be used with [link](#), [a](#), [area](#), and [form](#) elements. This keyword creates

a [hyperlink](#).

For [a](#), [area](#), and [form](#) elements, the [help](#) keyword indicates that the referenced document provides further help information for the parent of the element defining the hyperlink, and its children.

In the following example, the form control has associated context-sensitive help. The user agent could use this information, for example, displaying the referenced document if the user presses the "Help" or "F1" key.

```
<p><label> Topic: <input name=topic> <a href="help/topic.html" rel="help">(H
```

For [link](#) elements, the [help](#) keyword indicates that the referenced document provides help for the page as a whole.

For [a](#) and [area](#) elements, on some browsers, the [help](#) keyword causes the link to use a different cursor.

4.6.7.8 Link type "*icon*"



[Link_types#icon](#)

Support in all current engines.

Firefox 2+ Safari 3.1+ Chrome 4+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 4+ Safari iOS No Chrome Android 18+ WebView Android 38+ Samsung

Internet 4.0+ Opera Android No

[caniuse.com table](#)

The [icon](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#).

The specified resource is an icon representing the page or site, and should be used by the user agent when representing the page in the user interface.

Icons could be auditory icons, visual icons, or other kinds of icons. If multiple icons are provided, the user agent must select the most appropriate icon according to the [type](#), [media](#), and [sizes](#) attributes. If there are multiple equally appropriate icons, user agents must use the last one declared in [tree order](#) at the time that the user agent collected the list of icons. If the user agent tries to use an icon but that icon is determined, upon closer examination, to in fact be inappropriate (e.g. because it uses an unsupported format), then the user agent must try the next-most-appropriate icon as determined by the attributes.

User agents are not required to update icons when the list of icons changes, but are encouraged to do so.

There is no default type for resources given by the [icon](#) keyword. However, for the purposes of [determining the type of the resource](#), user agents must expect the resource to be an image.

The [sizes](#) keywords represent icon sizes in raw pixels (as opposed to [CSS pixels](#)).

An icon that is 50 [CSS pixels](#) wide intended for displays with a device pixel density of two device pixels per [CSS pixel](#) (2x, 192dpi) would have a width of 100 raw pixels. This feature does not support indicating that a different resource is to be used for small high-resolution icons vs large low-resolution icons (e.g. 50×50 2x vs 100×100 1x).

To parse and process the attribute's value, the user agent must first [split the attribute's value on ASCII whitespace](#), and must then parse each resulting keyword to determine what it represents.

The [any](#) keyword represents that the resource contains a scalable icon, e.g. as provided by an SVG image.

Other keywords must be further parsed as follows to determine what they represent:

- If the keyword doesn't contain exactly one U+0078 LATIN SMALL LETTER X or U+0058 LATIN CAPITAL LETTER X character, then this keyword doesn't represent anything. Return for that keyword.
- Let *width string* be the string before the "x" or "X".
- Let *height string* be the string after the "x" or "X".
- If either *width string* or *height string* start with a U+0030 DIGIT ZERO (0) character or contain any characters other than [ASCII digits](#), then this keyword doesn't represent anything. Return for that keyword.
- Apply the [rules for parsing non-negative integers](#) to *width string* to obtain *width*.
- Apply the [rules for parsing non-negative integers](#) to *height string* to obtain *height*.
- The keyword represents that the resource contains a bitmap icon with a width of *width* device pixels and a height of *height* device pixels.

The keywords specified on the [sizes](#) attribute must not represent icon sizes that are not actually available in the linked resource.

The [linked resource fetch setup steps](#) for this type of linked resource, given a [link](#) element *el* and [request](#) *request*, are:

1. Set *request*'s [destination](#) to "image".

2. Return true.

In the absence of a [link](#) with the [icon](#) keyword, for [Document](#) objects whose [URL](#)'s [scheme](#) is an [HTTP\(S\) scheme](#), user agents may instead run these steps [in parallel](#):

1. Let *request* be a new [request](#) whose [URL](#) is the [URL record](#) obtained by resolving the [URL](#) "/favicon.ico" against the [Document](#) object's [URL](#), [client](#) is the [Document](#) object's [relevant settings object](#), [destination](#) is "image", [synchronous flag](#) is set, [credentials mode](#) is "include", and whose [use-URL-credentials flag](#) is set.
2. Let *response* be the result of [fetching](#) *request*.
3. Use *response*'s [unsafe response](#) as an icon as if it had been declared using the [icon](#) keyword.

The following snippet shows the top part of an application with several icons.

```
<!DOCTYPE HTML>
<html lang="en">
  <head>
    <title>lsForums – Inbox</title>
    <link rel=icon href=favicon.png sizes="16x16" type="image/png">
    <link rel=icon href=windows.ico sizes="32x32 48x48" type="image/vnd.microsoft.icon">
    <link rel=icon href=mac.icns sizes="128x128 512x512 8192x8192 32768x32768">
    <link rel=icon href=iphone.png sizes="57x57" type="image/png">
    <link rel=icon href=gnome.svg sizes="any" type="image/svg+xml">
    <link rel=stylesheet href=lsforums.css>
    <script src=lsforums.js></script>
    <meta name=application-name content="lsForums">
  </head>
  <body>
    ...
  </body>
```

For historical reasons, the [icon](#) keyword may be preceded by the keyword "[shortcut](#)". If the "[shortcut](#)" keyword is present, the [rel](#) attribute's entire value must be an [ASCII case-insensitive](#) match for the string "[shortcut icon](#)" (with a single U+0020 SPACE character between the tokens and no other [ASCII whitespace](#)).

4.6.7.9 Link type "**license**"

The [license](#) keyword may be used with [link](#), [a](#), [area](#), and [form](#) elements. This keyword creates a [hyperlink](#).

The [license](#) keyword indicates that the referenced document provides the copyright license terms under which the main content of the current document is provided.

This specification does not specify how to distinguish between the main content of a document

and content that is not deemed to be part of that main content. The distinction should be made clear to the user.

Consider a photo sharing site. A page on that site might describe and show a photograph, and the page might be marked up as follows:

```
<!DOCTYPE HTML>
<html lang="en">
  <head>
    <title>Exampl Pictures: Kissat</title>
    <link rel="stylesheet" href="/style/default">
  </head>
  <body>
    <h1>Kissat</h1>
    <nav>
      <a href=". /">Return to photo index</a>
    </nav>
    <figure>
      
      <figcaption>Kissat</figcaption>
    </figure>
    <p>One of them has six toes!</p>
    <p><small><a rel="license" href="http://www.opensource.org/licenses/mit-lic...</a></small></p>
    <footer>
      <a href="/">Home</a> | <a href=". /">Photo index</a>
      <p><small>© copyright 2009 Exampl Pictures. All Rights Reserved.</small></p>
    </footer>
  </body>
</html>
```

In this case the [license](#) applies to just the photo (the main content of the document), not the whole document. In particular not the design of the page itself, which is covered by the copyright given at the bottom of the document. This could be made clearer in the styling (e.g. making the license link prominently positioned near the photograph, while having the page copyright in light small text at the foot of the page).

Synonyms: For historical reasons, user agents must also treat the keyword "[copyright](#)" like the [license](#) keyword.

4.6.7.10 Link type "**manifest**"

MDN

[Link_types/manifest](#)

Support in one engine only.

Firefox?Safari?ChromeNo

OperaNoEdgeNo

Edge (Legacy)NoInternet Explorer?

Firefox Android?Safari iOS?Chrome Android39+WebView Android39+Samsung Internet4.0+Opera Android?

The [manifest](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#).

The [manifest](#) keyword indicates the manifest file that provides metadata associated with the current document.

There is no default type for resources given by the [manifest](#) keyword.

When a web application is not [installed](#), the appropriate time to [fetch and process the linked resource](#) for this link type is when the user agent deems it necessary. For example, when the user chooses to [install the web application](#).

For an [installed web application](#), the appropriate times to [fetch and process the linked resource](#) for this link type are:

- When the [external resource link](#) is created on a [link](#) element that is already [browsing-context connected](#).
- When the [external resource link](#)'s [link](#) element [becomes browsing-context connected](#).
- When the [href](#) attribute of the [link](#) element of an [external resource link](#) that is already [browsing-context connected](#) is changed.

In either cases, only the first [link](#) element in [tree order](#) whose [rel](#) attribute contains the token [manifest](#) may be used.

A user agent must not [delay the load event](#) for this link type.

The [linked resource fetch setup steps](#) for this type of linked resource, given a [link](#) element *el* and [request](#) *request*, are:

1. Let *context* be *el*'s [node document](#)'s [browsing context](#).
2. If *context* is null, then return false.
3. If *context* is not a [top-level browsing context](#), then return false.
4. Set *request*'s [initiator](#) to "manifest".
5. Set *request*'s [destination](#) to "manifest".

6. Set *request*'s [mode](#) to "cors".
7. Set *request*'s [credentials mode](#) to the [CORS settings attribute credentials mode](#) for *el*'s [crossorigin](#) content attribute.
8. Return true.

To [process this type of linked resource](#) given a [link](#) element *el*, boolean *success*, and [response](#):

1. If *response*'s [Content-Type metadata](#) is not a [JSON MIME type](#), then set *success* to false.
2. If *success* is true, then [process the manifest](#) given *el* and *response*. [\[MANIFEST\]](#)

4.6.7.11 Link type "**modulepreload**"

MDN

[Link_types/modulepreload](#)

Support in one engine only.

Firefox?Safari?Chrome66+

Opera53+Edge79+

Edge (Legacy)NoInternet Explorer?

Firefox Android?Safari iOS?Chrome Android66+WebView Android66+Samsung Internet9.0+Opera Android47+

The [modulepreload](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#). This keyword is [body-ok](#).

The [modulepreload](#) keyword is a specialized alternative to the [preload](#) keyword, with a processing model geared toward preloading [module scripts](#). In particular, it uses the specific fetch behavior for module scripts (including, e.g., a different interpretation of the [crossorigin](#) attribute), and places the result into the appropriate [module map](#) for later evaluation. In contrast, a similar [external resource link](#) using the [preload](#) keyword would place the result in the preload cache, without affecting the document's [module map](#).

Additionally, implementations can take advantage of the fact that [module scripts](#) declare their dependencies in order to fetch the specified module's dependency as well. This is intended as an optimization opportunity, since the user agent knows that, in all likelihood, those dependencies will also be needed later. It will not generally be observable without using technology such as service workers, or monitoring on the server side. Notably, the appropriate [load](#) or [error](#) events will occur after the specified module is fetched, and will not wait for any dependencies.

The appropriate times to [fetch and process the linked resource](#) for such a link are:

- When the [external resource link](#) is created on a [link](#) element that is already [browsing-context connected](#).
- When the [external resource link](#)'s [link](#) element [becomes browsing-context connected](#).
- When the [href](#) attribute of the [link](#) element of an [external resource link](#) that is already [browsing-context connected](#) is changed.

Unlike some other link relations, changing the relevant attributes (such as [as](#), [crossorigin](#), and [referrerpolicy](#)) of such a [link](#) does not trigger a new fetch. This is because the document's [module map](#) has already been populated by a previous fetch, and so re-fetching would be pointless.

The [fetch and process the linked resource](#) algorithm for [modulepreload](#) links, given a [link](#) element el , is as follows:

1. If el 's [href](#) attribute's value is the empty string, then return.
2. Let $destination$ be the current state of the [as](#) attribute (a [destination](#)), or "[script](#)" if it is in no state.
3. If $destination$ is not [script-like](#), then [queue an element task](#) on the [networking task source](#) given the [link](#) element to [fire an event named error](#) at the [link](#) element, and return.
4. [Parse a URL](#) given el 's [href](#) attribute, relative to the element's [node document](#). If that fails, then return. Otherwise, let url be the [resulting URL record](#).
5. Let $settings\ object$ be the [link](#) element's [node document's relevant settings object](#).
6. Let $credentials\ mode$ be the [CORS settings attribute credentials mode](#) for the [crossorigin](#) attribute.
7. Let $cryptographic\ nonce$ be the current value of the element's [\[\[CryptographicNonce\]\]](#) internal slot.
8. Let $integrity\ metadata$ be the value of the [integrity](#) attribute, if it is specified, or the empty string otherwise.
9. Let $referrer\ policy$ be the current state of the element's [referrerpolicy](#) attribute.
10. Let $options$ be a [script fetch options](#) whose [cryptographic nonce](#) is $cryptographic\ nonce$, [integrity metadata](#) is $integrity\ metadata$, [parser metadata](#) is "not-parser-inserted", [credentials mode](#) is $credentials\ mode$, and [referrer policy](#) is $referrer\ policy$.
11. [Fetch a modulepreload module script graph](#) given url , $destination$, $settings\ object$, and $options$. Wait until the algorithm asynchronously completes with $result$.

12. If *result* is null, then [fire an event](#) named **error** at the [link](#) element, and return.

13. [Fire an event](#) named **load** at the [link](#) element.

The following snippet shows the top part of an application with several modules preloaded:

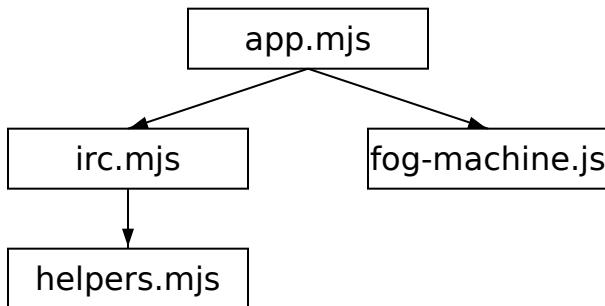
```
<!DOCTYPE html>
<html lang="en">
<title>IRCFog</title>

<link rel="modulepreload" href="app.mjs">
<link rel="modulepreload" href="helpers.mjs">
<link rel="modulepreload" href="irc.mjs">
<link rel="modulepreload" href="fog-machine.mjs">

<script type="module" src="app.mjs">
...

```

Assume that the module graph for the application is as follows:



Here we see the application developer has used [modulepreload](#) to declare all of the modules in their module graph, ensuring that the user agent initiates fetches for them all. Without such preloading, the user agent might need to go through multiple network roundtrips before discovering `helpers.mjs`, if technologies such as HTTP/2 Server Push are not in play. In this way, [modulepreload link](#) elements can be used as a sort of "manifest" of the application's modules.

The following code shows how [modulepreload](#) links can be used in conjunction with [import\(\)](#) to ensure network fetching is done ahead of time, so that when [import\(\)](#) is called, the module is already ready (but not evaluated) in the [module map](#):

```
<link rel="modulepreload" href="awesome-viewer.mjs">

<button onclick="import('./awesome-viewer.mjs').then(m => m.view())">
  View awesome thing
</button>
```

4.6.7.12 Link type "***nofollow***"

The ***nofollow*** keyword may be used with [a](#), [area](#), and [form](#) elements. This keyword does not create a [hyperlink](#), but [annotates](#) any other hyperlinks created by the element (the implied hyperlink, if no other keywords create one).

The ***nofollow*** keyword indicates that the link is not endorsed by the original author or publisher of the page, or that the link to the referenced document was included primarily because of a commercial relationship between people affiliated with the two pages.

4.6.7.13 Link type "***noopener***"



[Link_types/noopener](#)

Support in all current engines.

Firefox 52+ Safari 10.1+ Chrome 49+

Opera 36+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 52+ Safari iOS 10.3+ Chrome Android 49+ WebView Android 49+ Samsung Internet 5.0+ Opera Android 36+

[Link_types/noopener](#)

Support in all current engines.

Firefox 52+ Safari 10.1+ Chrome 49+

Opera 36+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 52+ Safari iOS 10.3+ Chrome Android 49+ WebView Android 49+ Samsung Internet 5.0+ Opera Android 36+

The ***noopener*** keyword may be used with [a](#), [area](#), and [form](#) elements. This keyword does not create a [hyperlink](#), but [annotates](#) any other hyperlinks created by the element (the implied hyperlink, if no other keywords create one).

The keyword indicates that any newly created [top-level browsing context](#) which results from following the [hyperlink](#) will not be an [auxiliary browsing context](#). E.g., its [`window.opener`](#) attribute will be null.

See also the [processing model](#) where the branching between an [auxiliary browsing context](#) and a [top-level browsing context](#) is defined.

This typically creates an [auxiliary browsing context](#) (assuming there is no existing [browsing](#)

[context](#) whose [browsing context name](#) is "example"):

```
<a href="help.html" target="example">Help!</a>
```

This creates a [top-level browsing context](#) that is not an [auxiliary browsing context](#) (assuming the same thing):

```
<a href="help.html" target="example" rel="noopener">Help!</a>
```

These are equivalent and only navigate the [parent browsing context](#):

```
<a href="index.html" target="_parent">Home</a>
```

```
<a href="index.html" target=_parent rel="noopener">Home</a>
```

4.6.7.14 Link type "**noreferrer**"



[Link_types/noreferrer](#)

Support in all current engines.

Firefox 33+ | Safari 5+ | Chrome 16+

Opera 15+ | Edge 79+

Edge (Legacy) 13+ | Internet Explorer 11

Firefox Android 33+ | Safari iOS 4.2+ | Chrome Android 18+ | WebView Android 3+ | Samsung Internet 1.5+ | Opera Android 14+

[Link_types/noreferrer](#)

Support in all current engines.

Firefox 33+ | Safari 5+ | Chrome 16+

Opera 15+ | Edge 79+

Edge (Legacy) 13+ | Internet Explorer 11

Firefox Android 33+ | Safari iOS 4.2+ | Chrome Android 18+ | WebView Android 3+ | Samsung Internet 1.5+ | Opera Android 14+

The [noreferrer](#) keyword may be used with [a](#), [area](#), and [form](#) elements. This keyword does not create a [hyperlink](#), but [annotates](#) any other hyperlinks created by the element (the implied hyperlink, if no other keywords create one).

It indicates that no referrer information is to be leaked when following the link and also implies the [noopener](#) keyword behavior under the same conditions.

See also the [processing model](#) where referrer is directly manipulated.

`` has the same behavior as ``.

4.6.7.15 Link type "**opener**"

The [opener](#) keyword may be used with [a](#), [area](#), and [form](#) elements. This keyword does not create a [hyperlink](#), but [annotates](#) any other hyperlinks created by the element (the implied hyperlink, if no other keywords create one).

The keyword indicates that any newly created [top-level browsing context](#) which results from following the [hyperlink](#) will be an [auxiliary browsing context](#).

See also the [processing model](#).

In the following example the [opener](#) is used to allow the help page popup to navigate its opener, e.g., in case what the user is looking for can be found elsewhere. An alternative might be to use a named target, rather than `_blank`, but this has the potential to clash with existing names.

```
<a href="..." rel="opener" target=_blank>Help!</a>
```

4.6.7.16 Link type "**pingback**"

The [pingback](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#). This keyword is [body-ok](#).

For the semantics of the [pingback](#) keyword, see *Pingback 1.0*. [\[PINGBACK\]](#)

4.6.7.17 Link type "**preconnect**"



[Link_types/preconnect](#)

Support in all current engines.

Firefox 39 + Safari 11.1 + Chrome 46 +

Opera 33 + Edge 79 +

Edge (Legacy) No Internet Explorer No

Firefox Android 39 + Safari iOS 11.3 + Chrome Android 46 + WebView Android 46 + Samsung Internet 4.0 + Opera Android 33 +

The [preconnect](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#). This keyword is [body-ok](#).

The [preconnect](#) keyword indicates that preemptively initiating a connection to the [origin](#) of the specified resource is likely to be beneficial, as it is highly likely that the user will require resources located at that [origin](#), and the user experience would be improved by preempting the latency costs associated with establishing the connection. User agents must implement the processing model of the [preconnect](#) keyword described in *Resource Hints*.

[[RESOURCEHINTS](#)]

There is no default type for resources given by the [preconnect](#) keyword.

4.6.7.18 Link type "**[prefetch](#)**"

MDN

[Link_types/prefetch](#)

Firefox2+SafariNoChrome8+

Opera15+Edge79+

Edge (Legacy)12+Internet Explorer11

Firefox Android4+Safari iOSNoChrome Android18+WebView Android4.4+Samsung Internet1.5+Opera Android14+

The [prefetch](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#). This keyword is [body-ok](#).

The [prefetch](#) keyword indicates that preemptively [fetching](#) and caching the specified resource is likely to be beneficial, as it is highly likely that the user will require this resource for future navigations. User agents must implement the processing model of the [prefetch](#) keyword described in *Resource Hints*. [[RESOURCEHINTS](#)]

There is no default type for resources given by the [prefetch](#) keyword.

4.6.7.19 Link type "**[preload](#)**"

ΔMDN

[Link_types/preload](#)

Support in one engine only.

Firefox85+Safari?Chrome?50+

Opera37+Edge?79+

Edge (Legacy)NoInternet Explorer?

Firefox Android85+Safari iOS?Chrome Android?50+WebView Android50+Samsung Internet5.0+Opera Android?

The **preload** keyword may be used with [link](#) elements. This keyword creates an [external resource link](#). This keyword is [body-ok](#).

The **preload** keyword indicates that the user agent must preemptively [fetch](#) and cache the specified resource according to the [potential destination](#) given by the [as](#) attribute (and the [priority](#) associated with the [corresponding destination](#)), as it is highly likely that the user will require this resource for the current navigation. User agents must implement the processing model of the **preload** keyword described in *Preload*, as well as in this specification's [fetch and process the linked resource](#) algorithm. [PRELOAD]

There is no default type for resources given by the **preload** keyword.

The [linked resource fetch setup steps](#) for this type of linked resource, given a [link](#) element *el* and [request](#) *request*, are:

1. Let *as* be the current state of *el*'s [as](#) attribute.
2. If *as* does not represent a state, return false.
3. Set *request*'s [destination](#) to the result of [translating](#) *as*.
4. If *as* is "image", then:
 1. Let *selected source* and *selected pixel density* be the URL and pixel density that results from [selecting an image source](#) given *el*, respectively.
 2. If *selected source* is null, then return false.
 3. Parse *selected source*, relative to *el*'s [node document](#). If that fails, then return false. Otherwise, let *url* be the [resulting URL record](#).
 4. Set *request*'s [URL](#) to *url*.
5. Return true.

4.6.7.20 Link type "**prerender**"

MDN

[Link_types/prerender](#)

Support in one engine only.

Firefox No Safari No Chrome 13+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer 11

Firefox Android No Safari iOS No Chrome Android 18+ WebView Android 4.4+ Samsung

Internet1.5+Opera Android14+

The [prerender](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#). This keyword is [body-ok](#).

The [prerender](#) keyword indicates that the specified resource might be required by the next navigation, and so it may be beneficial to not only preemptively [fetch](#) the resource, but also to process it, e.g. by [fetching](#) its subresources or performing some rendering. User agents must implement the processing model of the [prerender](#) keyword described in *Resource Hints*. [\[RESOURCEHINTS\]](#)

There is no default type for resources given by the [prerender](#) keyword.

4.6.7.21 Link type "**search**"

The [search](#) keyword may be used with [link](#), [a](#), [area](#), and [form](#) elements. This keyword creates a [hyperlink](#).

The [search](#) keyword indicates that the referenced document provides an interface specifically for searching the document and its related resources.

OpenSearch description documents can be used with [link](#) elements and the [search](#) link type to enable user agents to autodiscover search interfaces. [\[OPENSEARCH\]](#)

4.6.7.22 Link type "**stylesheet**"

The [stylesheet](#) keyword may be used with [link](#) elements. This keyword creates an [external resource link](#) that contributes to the styling processing model. This keyword is [body-ok](#).

The specified resource is a [CSS style sheet](#) that describes how to present the document.

If the [alternate](#) keyword is also specified on the [link](#) element, then *the link is an alternative style sheet*; in this case, the [title](#) attribute must be specified on the [link](#) element, with a non-empty value.

The default type for resources given by the [stylesheet](#) keyword is [text/css](#).

The appropriate times to [fetch and process](#) this type of link are:

- When the [external resource link](#) is created on a [link](#) element that is already [browsing-context connected](#).
- When the [external resource link's](#) [link](#) element [becomes browsing-context connected](#).
- When the [href](#) attribute of the [link](#) element of an [external resource link](#) that is already [browsing-context connected](#) is changed.

- When the `disabled` attribute of the `link` element of an external resource link that is already browsing-context connected is set, changed, or removed.
- When the `crossorigin` attribute of the `link` element of an external resource link that is already browsing-context connected is set, changed, or removed.
- When the `type` attribute of the `link` element of an external resource link that is already browsing-context connected is set or changed to a value that does not or no longer matches the Content-Type metadata of the previous obtained external resource, if any.
- When the `type` attribute of the `link` element of an external resource link that is already browsing-context connected, but was previously not obtained due to the `type` attribute specifying an unsupported type, is set, removed, or changed.
- When the external resource link that is already browsing-context connected changes from being an alternative style sheet to not being one, or vice versa.

Quirk: If the document has been set to quirks mode, has the same origin as the URL of the external resource, and the Content-Type metadata of the external resource is not a supported style sheet type, the user agent must instead assume it to be text/css.

The linked resource fetch setup steps for this type of linked resource, given a `link` element `el` (ignoring the `request`) are:

1. If `el`'s `disabled` attribute is set, then return false.
2. If `el` contributes a script-blocking style sheet, increment `el`'s node document's script-blocking style sheet counter by 1.
3. Return true.

See issue #968 for plans to use the CSSOM fetch a CSS style sheet algorithm instead of the default fetch and process the linked resource algorithm.

To process this type of linked resource given a `link` element `el`, boolean `success`, and response, the user agent must run these steps:

1. If the resource's Content-Type metadata is not text/css, then set `success` to false.
2. If `el` no longer creates an external resource link that contributes to the styling processing model, or if, since the resource in question was fetched, it has become appropriate to fetch it again, then return.
3. If `el` has an associated CSS style sheet, remove the CSS style sheet.
4. If `success` is true, then:

1. Create a CSS style sheet with the following properties:

[type](#)

[text/css](#)

[location](#)

The [resulting URL string](#) determined during the [fetch and process the linked resource](#) algorithm.

This is before any redirects get applied.

[owner node](#)

element

[media](#)

The [media](#) attribute of *element*.

This is a reference to the (possibly absent at this time) attribute, rather than a copy of the attribute's current value. *CSSOM* defines what happens when the attribute is dynamically set, changed, or removed.

[title](#)

The [title](#) attribute of *element*, if *element* is [in a document tree](#), or the empty string otherwise.

This is similarly a reference to the attribute, rather than a copy of the attribute's current value.

[alternate flag](#)

Set if [the link is an alternative style sheet](#) and *element*'s [explicitly enabled](#) is false; unset otherwise.

[origin-clean flag](#)

Set if the resource is [CORS-same-origin](#); unset otherwise.

[parent CSS style sheet](#)

[owner CSS rule](#)

null

[disabled flag](#)

Left at its default value.

[CSS rules](#)

Left uninitialized.

This doesn't seem right. Presumably we should be using the response body?
Tracked as [issue #2997](#).

The CSS [environment encoding](#) is the result of running the following steps:
[\[CSSSYNTAX\]](#)

1. If the element has a [charset](#) attribute, [get an encoding](#) from that attribute's value. If that succeeds, return the resulting encoding.
[\[ENCODING\]](#)
2. Otherwise, return the [document's character encoding](#). [\[DOM\]](#)
2. [Fire an event](#) named [load](#) at *el*.
5. Otherwise, [fire an event](#) named [error](#) at *el*.
6. If *el* [contributes a script-blocking style sheet, then:
 1. Assert: *el*'s \[node document\]\(#\)'s \[script-blocking style sheet counter\]\(#\) is greater than 0.
 2. Decrement *el*'s \[node document\]\(#\)'s \[script-blocking style sheet counter\]\(#\) by 1.](#)

4.6.7.23 Link type "**tag**"

The [tag](#) keyword may be used with [a](#) and [area](#) elements. This keyword creates a [hyperlink](#).

The [tag](#) keyword indicates that the *tag* that the referenced document represents applies to the current document.

Since it indicates that the tag *applies to the current document*, it would be inappropriate to use this keyword in the markup of a [tag cloud](#), which lists the popular tags across a set of pages.

This document is about some gems, and so it is *tagged* with "<https://en.wikipedia.org/wiki/Gemstone>" to unambiguously categorize it as applying to the "jewel" kind of gems, and not to, say, the towns in the US, the Ruby package format, or the Swiss locomotive class:

```
<!DOCTYPE HTML>
<html lang="en">
  <head>
    <title>My Precious</title>
```

```

</head>
<body>
<header><h1>My precious</h1> <p>Summer 2012</p></header>
<p>Recently I managed to dispose of a red gem that had been
bothering me. I now have a much nicer blue sapphire.</p>
<p>The red gem had been found in a bauxite stone while I was digging
out the office level, but nobody was willing to haul it away. The
same red gem stayed there for literally years.</p>
<footer>
  Tags: <a rel=tag href="https://en.wikipedia.org/wiki/Gemstone">Gemstone</a>
</footer>
</body>
</html>

```

In *this* document, there are two articles. The "[tag](#)" link, however, applies to the whole page (and would do so wherever it was placed, including if it was within the [article](#) elements).

```

<!DOCTYPE HTML>
<html lang="en">
  <head>
    <title>Gem 4/4</title>
  </head>
  <body>
    <article>
      <h1>801: Steinbock</h1>
      <p>The number 801 Gem 4/4 electro-diesel has an ibex and was rebuilt in 2000.
    </article>
    <article>
      <h1>802: Murmeltier</h1>
      <figure>
        
        <figcaption>The 802 in the 1980s, above Lago Bianco.</figcaption>
      </figure>
      <p>The number 802 Gem 4/4 electro-diesel has a marmot and was rebuilt in 2000.
    </article>
    <p class="topic"><a rel=tag href="https://en.wikipedia.org/wiki/Rhaetian_Railway">Rhaetian Railway</a>
  </body>
</html>

```

4.6.7.24 Sequential link types

Some documents form part of a sequence of documents.

A sequence of documents is one where each document can have a *previous sibling* and a *next sibling*. A document with no previous sibling is the start of its sequence, a document with no next sibling is the end of its sequence.

A document may be part of multiple sequences.

4.6.7.24.1 Link type "**next**"

The **next** keyword may be used with [link](#), [a](#), [area](#), and [form](#) elements. This keyword creates a [hyperlink](#).

The **next** keyword indicates that the document is part of a sequence, and that the link is leading to the document that is the next logical document in the sequence.

When the **next** keyword is used with a [link](#) element, user agents should implement one of the processing models described in *Resource Hints*, i.e. should process such links as if they were using one of the [dns-prefetch](#), [preconnect](#), [prefetch](#), or [prerender](#) keywords. Which resource hint the user agent wishes to use is implementation-dependent; for example, a user agent may wish to use the less-costly [preconnect](#) hint when trying to conserve data, battery power, or processing power, or may wish to pick a resource hint depending on heuristic analysis of past user behavior in similar scenarios. [\[RESOURCEHINTS\]](#)

4.6.7.24.2 Link type "**prev**"

The **prev** keyword may be used with [link](#), [a](#), [area](#), and [form](#) elements. This keyword creates a [hyperlink](#).

The **prev** keyword indicates that the document is part of a sequence, and that the link is leading to the document that is the previous logical document in the sequence.

Synonyms: For historical reasons, user agents must also treat the keyword "**previous**" like the [prev](#) keyword.

4.6.7.25 Other link types

Extensions to the predefined set of link types may be registered on the [microformats page for existing rel values](#). [\[MFREL\]](#)

Anyone is free to edit the microformats page for existing rel values at any time to add a type. Extension types must be specified with the following information:

Keyword

The actual value being defined. The value should not be confusingly similar to any other defined value (e.g. differing only in case).

If the value contains a U+003A COLON character (:), it must also be an [absolute URL](#).

Effect on... [link](#)

One of the following:

Not allowed

The keyword must not be specified on [link](#) elements.

Hyperlink

The keyword may be specified on a [link](#) element; it creates a [hyperlink](#).

External Resource

The keyword may be specified on a [link](#) element; it creates an [external resource link](#).

Effect on... [a](#) and [area](#)

One of the following:

Not allowed

The keyword must not be specified on [a](#) and [area](#) elements.

Hyperlink

The keyword may be specified on [a](#) and [area](#) elements; it creates a [hyperlink](#).

External Resource

The keyword may be specified on [a](#) and [area](#) elements; it creates an [external resource link](#).

Hyperlink Annotation

The keyword may be specified on [a](#) and [area](#) elements; it [annotates](#) other [hyperlinks](#) created by the element.

Effect on... [form](#)

One of the following:

Not allowed

The keyword must not be specified on [form](#) elements.

Hyperlink

The keyword may be specified on [form](#) elements; it creates a [hyperlink](#).

External Resource

The keyword may be specified on [form](#) elements; it creates an [external resource link](#).

Hyperlink Annotation

The keyword may be specified on [form](#) elements; it [annotates](#) other [hyperlinks](#) created by the element.

Brief description

A short non-normative description of what the keyword's meaning is.

Specification

A link to a more detailed description of the keyword's semantics and requirements. It could be another page on the wiki, or a link to an external page.

Synonyms

A list of other keyword values that have exactly the same processing requirements.

Authors should not use the values defined to be synonyms, they are only intended to allow user agents to support legacy content. Anyone may remove synonyms that are not used in practice; only names that need to be processed as synonyms for compatibility with legacy content are to be registered in this way.

Status

One of the following:

Proposed

The keyword has not received wide peer review and approval. Someone has proposed it and is, or soon will be, using it.

Ratified

The keyword has received wide peer review and approval. It has a specification that unambiguously defines how to handle pages that use the keyword, including when they use it in incorrect ways.

Discontinued

The keyword has received wide peer review and it has been found wanting. Existing pages are using this keyword, but new pages should avoid it. The "brief description" and "specification" entries will give details of what authors should use instead, if anything.

If a keyword is found to be redundant with existing values, it should be removed and listed as a synonym for the existing value.

If a keyword is registered in the "proposed" state for a period of a month or more without being used or specified, then it may be removed from the registry.

If a keyword is added with the "proposed" status and found to be redundant with existing values, it should be removed and listed as a synonym for the existing value. If a keyword is added with the "proposed" status and found to be harmful, then it should be changed to "discontinued" status.

Anyone can change the status at any time, but should only do so in accordance with the

definitions above.

Conformance checkers must use the information given on the microformats page for existing rel values to establish if a value is allowed or not: values defined in this specification or marked as "proposed" or "ratified" must be accepted when used on the elements for which they apply as described in the "Effect on..." field, whereas values marked as "discontinued" or not listed in either this specification or on the aforementioned page must be rejected as invalid. Conformance checkers may cache this information (e.g. for performance reasons or to avoid the use of unreliable network connectivity).

When an author uses a new type not defined by either this specification or the wiki page, conformance checkers should offer to add the value to the wiki, with the details described above, with the "proposed" status.

Types defined as extensions in the [microformats page for existing rel values](#) with the status "proposed" or "ratified" may be used with the `rel` attribute on [link](#), [a](#), and [area](#) elements in accordance to the "Effect on..." field. [\[MFREL\]](#)

4.7 Edits

The [ins](#) and [del](#) elements represent edits to the document.

4.7.1 The [ins](#) element



[Element/ins](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

[Flow content.](#)

[Phrasing content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

[Content model:](#)

[Transparent.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

[cite](#) — Link to the source of the quotation or more information about the edit

[datetime](#) — Date and (optionally) time of the change

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTMLModElement](#).

The [ins](#) element [represents](#) an addition to the document.

The following represents the addition of a single paragraph:

```
<aside>
  <ins>
    <p> I like fruit. </p>
  </ins>
</aside>
```

As does the following, because everything in the [aside](#) element here counts as [phrasing content](#) and therefore there is just one [paragraph](#):

```
<aside>
  <ins>
    Apples are <em>tasty</em>.
  </ins>
  <ins>
    So are pears.
  </ins>
</aside>
```

[ins](#) elements should not cross [implied paragraph](#) boundaries.

The following example represents the addition of two paragraphs, the second of which was inserted in two parts. The first [ins](#) element in this example thus crosses a paragraph boundary, which is considered poor form.

```
<aside>
  <!-- don't do this -->
```

```

<ins datetime="2005-03-16 00:00Z">
  <p> I like fruit. </p>
  Apples are <em>tasty</em>.
</ins>
<ins datetime="2007-12-19 00:00Z">
  So are pears.
</ins>
</aside>

```

Here is a better way of marking this up. It uses more elements, but none of the elements cross implied paragraph boundaries.

```

<aside>
  <ins datetime="2005-03-16 00:00Z">
    <p> I like fruit. </p>
  </ins>
  <ins datetime="2005-03-16 00:00Z">
    Apples are <em>tasty</em>.
  </ins>
  <ins datetime="2007-12-19 00:00Z">
    So are pears.
  </ins>
</aside>

```

4.7.2 The **del** element



[Element/del](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

[Flow content](#).

[Phrasing content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Transparent](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

cite — Link to the source of the quotation or more information about the edit

datetime — Date and (optionally) time of the change

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses HTMLModElement.

The del element represents a removal from the document.

del elements should not cross implied paragraph boundaries.

The following shows a "to do" list where items that have been done are crossed-off with the date and time of their completion.

```
<h1>To Do</h1>
<ul>
  <li>Empty the dishwasher</li>
  <li><del datetime="2009-10-11T01:25-07:00">Watch Walter Lewin's lectures</del></li>
  <li><del datetime="2009-10-10T23:38-07:00">Download more tracks</del></li>
  <li>Buy a printer</li>
</ul>
```

4.7.3 Attributes common to ins and del elements

The cite attribute may be used to specify the URL of a document that explains the change. When that document is long, for instance the minutes of a meeting, authors are encouraged to include a fragment pointing to the specific part of that document that discusses the change.

If the cite attribute is present, it must be a valid URL potentially surrounded by spaces that explains the change. To obtain the corresponding citation link, the value of the attribute must be parsed relative to the element's node document. User agents may allow users to follow such citation links, but they are primarily intended for private use (e.g., by server-side scripts collecting statistics about a site's edits), not for readers.

The datetime attribute may be used to specify the time and date of the change.

If present, the datetime attribute's value must be a valid date string with optional time.

User agents must parse the `datetime` attribute according to the [parse a date or time string](#) algorithm. If that doesn't return a `date` or a [global date and time](#), then the modification has no associated timestamp (the value is non-conforming; it is not a [valid date string with optional time](#)). Otherwise, the modification is marked as having been made at the given `date` or [global date and time](#). If the given value is a [global date and time](#) then user agents should use the associated time-zone offset information to determine which time zone to present the given datetime in.

This value may be shown to the user, but it is primarily intended for private use.

The `ins` and `del` elements must implement the [HTMLModElement](#) interface:



[HTMLModElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

```
[Exposed=Window]
interface HTMLModElement : HTMLElement {
    [HTMLConstructor] constructor();
    [CEReactions] attribute USVString cite;
    [CEReactions] attribute DOMString dateTime;
};
```

The `cite` IDL attribute must [reflect](#) the element's `cite` content attribute. The `dateTime` IDL attribute must [reflect](#) the element's `datetime` content attribute.

4.7.4 Edits and paragraphs

This section is non-normative.

Since the `ins` and `del` elements do not affect [paragraphing](#), it is possible, in some cases where paragraphs are [implied](#) (without explicit `p` elements), for an `ins` or `del` element to span both an entire paragraph or other non-[phrasing content](#) elements and part of another paragraph. For example:

```
<section>
  <ins>
```

```

<p>
  This is a paragraph that was inserted.
</p>
This is another paragraph whose first sentence was inserted
at the same time as the paragraph above.
</ins>
  This is a second sentence, which was there all along.
</section>

```

By only wrapping some paragraphs in `p` elements, one can even get the end of one paragraph, a whole second paragraph, and the start of a third paragraph to be covered by the same `ins` or `del` element (though this is very confusing, and not considered good practice):

```

<section>
  This is the first paragraph. <ins>This sentence was
  inserted.
  <p>This second paragraph was inserted.</p>
  This sentence was inserted too.</ins> This is the
  third paragraph in this example.
  <!-- (don't do this) -->
</section>

```

However, due to the way [implied paragraphs](#) are defined, it is not possible to mark up the end of one paragraph and the start of the very next one using the same `ins` or `del` element. You instead have to use one (or two) `p` element(s) and two `ins` or `del` elements, as for example:

```

<section>
  <p>This is the first paragraph. <del>This sentence was
  deleted.</del></p>
  <p><del>This sentence was deleted too.</del> That
  sentence needed a separate &lt;del&gt; element.</p>
</section>

```

Partly because of the confusion described above, authors are strongly encouraged to always mark up all paragraphs with the `p` element, instead of having `ins` or `del` elements that cross [implied paragraphs](#) boundaries.

4.7.5 Edits and lists

This section is non-normative.

The content models of the `ol` and `ul` elements do not allow `ins` and `del` elements as children. Lists always represent all their items, including items that would otherwise have been marked as deleted.

To indicate that an item is inserted or deleted, an `ins` or `del` element can be wrapped around the contents of the `li` element. To indicate that an item has been replaced by another, a single

[li](#) element can have one or more [del](#) elements followed by one or more [ins](#) elements.

In the following example, a list that started empty had items added and removed from it over time. The bits in the example that have been emphasized show the parts that are the "current" state of the list. The list item numbers don't take into account the edits, though.

```
<h1>Stop-ship bugs</h1>
<ol>
  <li><ins datetime="2008-02-12T15:20Z">Bug 225:
    Rain detector doesn't work in snow</ins></li>
  <li><del datetime="2008-03-01T20:22Z"><ins datetime="2008-02-14T12:02Z">Bug 226:
    Water buffer overflows in April</ins></del></li>
  <li><ins datetime="2008-02-16T13:50Z">Bug 230:
    Water heater doesn't use renewable fuels</ins></li>
  <li><del datetime="2008-02-20T21:15Z"><ins datetime="2008-02-16T14:25Z">Bug 231:
    Carbon dioxide emissions detected after startup</ins></del></li>
</ol>
```

In the following example, a list that started with just fruit was replaced by a list with just colors.

```
<h1>List of <del>fruits</del><ins>colors</ins></h1>
<ul>
  <li><del>Lime</del><ins>Green</ins></li>
  <li><del>Apple</del></li>
  <li>Orange</li>
  <li><del>Pear</del></li>
  <li><ins>Teal</ins></li>
  <li><del>Lemon</del><ins>Yellow</ins></li>
  <li>Olive</li>
  <li><ins>Purple</ins></li>
</ul>
```

4.7.6 Edits and tables

This section is non-normative.

The elements that form part of the table model have complicated content model requirements that do not allow for the [ins](#) and [del](#) elements, so indicating edits to a table can be difficult.

To indicate that an entire row or an entire column has been added or removed, the entire contents of each cell in that row or column can be wrapped in [ins](#) or [del](#) elements (respectively).

Here, a table's row has been added:

```
<table>
```

```

<thead>
  <tr> <th> Game name           <th> Game publisher   <th> Verdict
<tbody>
  <tr> <td> Diablo 2          <td> Blizzard        <td> 8/10
  <tr> <td> Portal             <td> Valve            <td> 10/10
  <tr> <td> <ins>Portal 2</ins> <td> <ins>Valve</ins> <td> <ins>10/10</ins>
</table>

```

Here, a column has been removed (the time at which it was removed is given also, as is a link to the page explaining why):

```

<table>
  <thead>
    <tr> <th> Game name           <th> Game publisher   <th> <del cite="/edits/>
  <tbody>
    <tr> <td> Diablo 2          <td> Blizzard        <td> <del cite="/edits/>
    <tr> <td> Portal             <td> Valve            <td> <del cite="/edits/>
    <tr> <td> Portal 2           <td> Valve            <td> <del cite="/edits/>
</table>

```

Generally speaking, there is no good way to indicate more complicated edits (e.g. that a cell was removed, moving all subsequent cells up or to the left).

4.8 Embedded content

4.8.1 The ***picture*** element



[Element/picture](#)

Support in all current engines.

Firefox 38+ Safari 9.1+ Chrome 38+

Opera 25+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 38+ Safari iOS 9.3+ Chrome Android 38+ WebView Android 38+ Samsung Internet 3.0+ Opera Android 25+



[HTMLPictureElement](#)

Support in all current engines.

Firefox 38+ Safari 9.1+ Chrome 38+

Opera 25+ Edge 79+

Edge (Legacy)13+Internet ExplorerNo

Firefox Android38+Safari iOS9.3+Chrome Android38+WebView Android38+Samsung Internet3.0+Opera Android25+

Categories:

Flow content.

Phrasing content.

Embedded content.

Contexts in which this element can be used:

Where embedded content is expected.

Content model:

Zero or more source elements, followed by one img element, optionally intermixed with script-supporting elements.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLPictureElement : HTMLElement {
    [HTMLConstructor] constructor();
};
```

The **picture** element is a container which provides multiple sources to its contained **img** element to allow authors to declaratively control or give hints to the user agent about which image resource to use, based on the screen pixel density, viewport size, image format, and other factors. It represents its children.

The **picture** element is somewhat different from the similar-looking **video** and **audio** elements. While all of them contain source elements, the source element's src attribute has no meaning when the element is nested within a **picture** element, and the resource selection algorithm is different. Also, the **picture** element itself does not display anything; it merely provides a context for its contained **img** element that enables it to choose from multiple URLs.

4.8.2 The **source** element

✓MDN

Element/source

Support in all current engines.

Firefox 3.5+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

HTMLSourceElement

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

None.

Contexts in which this element can be used:

As a child of a [picture](#) element, before the [img](#) element.

As a child of a [media element](#), before any [flow content](#) or [track](#) elements.

Content model:

Nothing.

Tag omission in text/html:

No end tag.

Content attributes:

Global attributes

type — Type of embedded resource

src (in [video](#) or [audio](#)) — Address of the resource

srcset (in [picture](#)) — Images to use in different situations, e.g., high-resolution displays, small monitors, etc.

[sizes](#) (in [picture](#)) — Image sizes for different page layouts

[media](#) (in [picture](#)) — Applicable media

[width](#) (in [picture](#)) — Horizontal dimension

[height](#) (in [picture](#)) — Vertical dimension

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLSourceElement : HTMLElement {
  HTMLConstructor constructor();

  CEReactions attribute USVString src;
  CEReactions attribute DOMString type;
  CEReactions attribute USVString srcset;
  CEReactions attribute DOMString sizes;
  CEReactions attribute DOMString media;
  CEReactions attribute unsigned long width;
  CEReactions attribute unsigned long height;
};
```

The [source](#) element allows authors to specify multiple alternative [source sets](#) for [img](#) elements or multiple alternative [media resources](#) for [media elements](#). It does not [represent](#) anything on its own.

The [type](#) attribute may be present. If present, the value must be a [valid MIME type string](#).

The remainder of the requirements depend on whether the parent is a [picture](#) element or a [media element](#):

The [source](#) element's parent is a [picture](#) element

The [srcset](#) attribute must be present, and is a [srcset attribute](#).

The [srcset](#) attribute contributes the [image sources](#) to the [source set](#), if the [source](#) element is selected.

If the [srcset](#) attribute has any [image candidate strings](#) using a [width descriptor](#), the [sizes](#) attribute must also be present, and is a [sizes attribute](#). The [sizes](#) attribute contributes the [source size](#) to the [source set](#), if the [source](#) element is selected.

The **media** attribute may also be present. If present, the value must contain a [valid media query list](#). The user agent will skip to the next **source** element if the value does not [match the environment](#).

The **source** element supports [dimension attributes](#). The **img** element can use the **width** and **height** attributes of a **source** element, instead of those on the **img** element itself, to determine its rendered dimensions and aspect-ratio, [as defined in the Rendering section](#).

The **type** attribute gives the type of the images in the [source set](#), to allow the user agent to skip to the next **source** element if it does not support the given type.

If the **type** attribute is *not* specified, the user agent will not select a different **source** element if it finds that it does not support the image format after fetching it.

When a **source** element has a following sibling **source** element or **img** element with a **srcset** attribute specified, it must have at least one of the following:

- A **media** attribute specified with a value that, after [stripping leading and trailing ASCII whitespace](#), is not the empty string and is not an [ASCII case-insensitive](#) match for the string "**all**".
- A **type** attribute specified.

The **src** attribute must not be present.

The **source** element's parent is a [media element](#)

The **src** attribute gives the [URL](#) of the [media resource](#). The value must be a [valid non-empty URL potentially surrounded by spaces](#). This attribute must be present.

Dynamically modifying a **source** element and its attribute when the element is already inserted in a **video** or **audio** element will have no effect. To change what is playing, just use the **src** attribute on the [media element](#) directly, possibly making use of the [canPlayType\(\)](#) method to pick from amongst available resources. Generally, manipulating **source** elements manually after the document has been parsed is an unnecessarily complicated approach.

The **type** attribute gives the type of the [media resource](#), to help the user agent determine if it can play this [media resource](#) before fetching it. The **codecs** parameter, which certain MIME types define, might be necessary to specify exactly how the resource is encoded.
[\[RFC6381\]](#)

The following list shows some examples of how to use the **codecs**= MIME parameter in the **type** attribute.

H.264 Constrained baseline profile video (main and extended video compatible) level 3 and Low-Complexity AAC audio in MP4 container

```
<source src='video.mp4' type='video/mp4; codecs="avc1.42E01E, mp4a.40.2">
```

H.264 Extended profile video (baseline-compatible) level 3 and Low-Complexity AAC audio in MP4 container

```
<source src='video.mp4' type='video/mp4; codecs="avc1.58A01E, mp4a.40.2">
```

H.264 Main profile video level 3 and Low-Complexity AAC audio in MP4 container

```
<source src='video.mp4' type='video/mp4; codecs="avc1.4D401E, mp4a.40.2">
```

H.264 'High' profile video (incompatible with main, baseline, or extended profiles) level 3 and Low-Complexity AAC audio in MP4 container

```
<source src='video.mp4' type='video/mp4; codecs="avc1.64001E, mp4a.40.2">
```

MPEG-4 Visual Simple Profile Level 0 video and Low-Complexity AAC audio in MP4 container

```
<source src='video.mp4' type='video/mp4; codecs="mp4v.20.8, mp4a.40.2">
```

MPEG-4 Advanced Simple Profile Level 0 video and Low-Complexity AAC audio in MP4 container

```
<source src='video.mp4' type='video/mp4; codecs="mp4v.20.240, mp4a.40.2">
```

MPEG-4 Visual Simple Profile Level 0 video and AMR audio in 3GPP container

```
<source src='video.3gp' type='video/3gpp; codecs="mp4v.20.8, samr">
```

Theora video and Vorbis audio in Ogg container

```
<source src='video.ogv' type='video/ogg; codecs="theora, vorbis"'>
```

Theora video and Speex audio in Ogg container

```
<source src='video.ogv' type='video/ogg; codecs="theora, speex"'>
```

Vorbis audio alone in Ogg container

```
<source src='audio.ogg' type='audio/ogg; codecs=vorbis'>
```

Speex audio alone in Ogg container

```
<source src='audio.spx' type='audio/ogg; codecs=speex'>
```

FLAC audio alone in Ogg container

```
<source src='audio.oga' type='audio/ogg; codecs=flac'>
```

Dirac video and Vorbis audio in Ogg container

```
<source src='video.ogv' type='video/ogg; codecs="dirac, vorbis"'>
```

The [srcset](#), [sizes](#), and [media](#) attributes must not be present.

If a [source element is inserted](#) as a child of a [media element](#) that has no [src](#) attribute and whose [networkState](#) has the value [NETWORK_EMPTY](#), the user agent must invoke the [media element's resource selection algorithm](#).

The IDL attributes *src*, *type*, *srcset*, *sizes* and *media* must [reflect](#) the respective content attributes of the same name.

If the author isn't sure if user agents will all be able to render the media resources provided, the author can listen to the [error](#) event on the last [source](#) element and trigger fallback behavior:

```
<script>
  function fallback(video) {
    // replace <video> with its contents
    while (video.hasChildNodes()) {
      if (video.firstChild instanceof HTMLSourceElement)
        video.removeChild(video.firstChild);
      else
        video.parentNode.insertBefore(video.firstChild, video);
    }
    video.parentNode.removeChild(video);
  }
</script>
<video controls autoplay>
  <source src='video.mp4' type='video/mp4; codecs="avc1.42E01E, mp4a.40.2"'>
  <source src='video.ogv' type='video/ogg; codecs="theora, vorbis"' onerror="fallback(parentNode)">
  ...
</video>
```

4.8.3 The *img* element



[Element/img](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLImageElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 8+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Categories:

[Flow content](#).

[Phrasing content](#).

[Embedded content](#).

[Form-associated element](#).

If the element has a [usemap](#) attribute: [Interactive content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [embedded content](#) is expected.

Content model:

[Nothing](#).

Tag omission in text/html:

No [end tag](#).

Content attributes:

[Global attributes](#)

alt — Replacement text for use when images are not available

src — Address of the resource

srcset — Images to use in different situations, e.g., high-resolution displays, small monitors, etc.

[sizes](#) — Image sizes for different page layouts

[crossorigin](#) — How the element handles crossorigin requests

[usemap](#) — Name of [image map](#) to use

[ismap](#) — Whether the image is a server-side image map

[width](#) — Horizontal dimension

[height](#) — Vertical dimension

[referrerpolicy](#) — [Referrer policy](#) for [fetches](#) initiated by the element

[decoding](#) — Decoding hint to use when processing this image for presentation

[loading](#) — Used when determining loading deferral

[Accessibility considerations:](#)

If the element has a non-empty [alt](#) attribute: [for authors](#); [for implementers](#).

Otherwise: [for authors](#); [for implementers](#).

[DOM interface:](#)

```
[Exposed=Window,
LegacyFactoryFunction=Image(optional unsigned long width, optional unsigned long height, optional unsigned long naturalWidth, optional unsigned long naturalHeight),
interface HTMLImageElement : HTMLElement {
    [HTMLConstructor] constructor();

    [CEReactions] attribute DOMString alt;
    [CEReactions] attribute USVString src;
    [CEReactions] attribute USVString srcset;
    [CEReactions] attribute DOMString sizes;
    [CEReactions] attribute DOMString? crossorigin;
    [CEReactions] attribute DOMString useMap;
    [CEReactions] attribute boolean isMap;
    [CEReactions] attribute unsigned long width;
    [CEReactions] attribute unsigned long height;
    readonly attribute unsigned long naturalWidth;
    readonly attribute unsigned long naturalHeight;
    readonly attribute boolean complete;
    readonly attribute USVString currentSrc;
    [CEReactions] attribute DOMString referrerPolicy;
    [CEReactions] attribute DOMString decoding;
    [CEReactions] attribute DOMString loading;

    Promise<undefined> decode();
}
```

```
// also has obsolete members  
};
```

An [img](#) element represents an image.

An [img](#) element has a *dimension attribute source*, initially set to the element itself.



[Element/img#attr-srcset](#)

Support in all current engines.

Firefox 38+ Safari 8+ Chrome 34+

Opera 21+ Edge 79+

Edge (Legacy) ≤ 18+ Internet Explorer No

Firefox Android 38+ Safari iOS 8+ Chrome Android 34+ WebView Android 37+ Samsung Internet 2.0+ Opera Android 21+

The image given by the **src** and **srcset** attributes, and any previous sibling [source](#) elements' [srcset](#) attributes if the parent is a [picture](#) element, is the embedded content; the value of the **alt** attribute provides equivalent content for those who cannot process images or who have image loading disabled (i.e. it is the [img](#) element's [fallback content](#)).

The requirements on the **alt** attribute's value are described [in a separate section](#).

The **src** attribute must be present, and must contain a [valid non-empty URL potentially surrounded by spaces](#) referencing a non-interactive, optionally animated, image resource that is neither paged nor scripted.

The requirements above imply that images can be static bitmaps (e.g. PNGs, GIFs, JPEGs), single-page vector documents (single-page PDFs, XML files with an SVG document element), animated bitmaps (APNGs, animated GIFs), animated vector graphics (XML files with an SVG [document element](#) that use declarative SMIL animation), and so forth. However, these definitions preclude SVG files with script, multipage PDF files, interactive MNG files, HTML documents, plain text documents, and the like. [\[PNG\]](#) [\[GIF\]](#) [\[JPEG\]](#) [\[PDF\]](#) [\[XML\]](#) [\[APNG\]](#) [\[SVG\]](#) [\[MNG\]](#)

The **srcset** attribute may also be present, and is a [srcset attribute](#).

The **srcset** attribute and the **src** attribute (if [width descriptors](#) are not used) contribute the [image sources](#) to the [source set](#) (if no [source](#) element was selected).

If the **srcset** attribute is present and has any [image candidate strings](#) using a [width descriptor](#), the **sizes** attribute must also be present, and is a [sizes attribute](#). The [sizes](#)

attribute contributes the [source size](#) to the [source set](#) (if no [source](#) element was selected).



[Attributes/crossorigin](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

The *crossorigin* attribute is a [CORS settings attribute](#). Its purpose is to allow images from third-party sites that allow cross-origin access to be used with [canvas](#).

The *referrerpolicy* attribute is a [referrer policy attribute](#). Its purpose is to set the [referrer policy](#) used when [fetching](#) the image. [\[REFERRERPOLICY\]](#)

The *decoding* attribute indicates the preferred method to [decode](#) this image. The attribute, if present, must be an [image decoding hint](#). This attribute's [missing value default](#) and [invalid value default](#) are both the [auto](#) state.

The *loading* attribute is a [lazy loading attribute](#). Its purpose is to indicate the policy for loading images that are outside the viewport.

When the [loading](#) attribute's state is changed to the [Eager](#) state, the user agent must run these steps:

1. Let *resumptionSteps* be the [img](#) element's [lazy load resumption steps](#).
2. If *resumptionSteps* is null, then return.
3. Set the [img](#)'s [lazy load resumption steps](#) to null.
4. Invoke *resumptionSteps*.

```



<div id=very-large></div> <!-- Everything after this div is below the viewpor


```

In the example above, the images load as follows:

1.jpeg, 2.jpeg, 4.jpeg

The images load eagerly and delay the window's load event.

3.jpeg

The image loads when layout is known, due to being in the viewport, however it does not delay the window's load event.

5.jpeg

The image loads only once scrolled into the viewport, and does not delay the window's load event.

Developers are encouraged to specify an intrinsic aspect ratio via [width](#) and [height](#) attributes on lazy loaded images, even if CSS sets the image's width and height properties, to prevent the page layout from shifting around after the image loads.

The [img](#) element must not be used as a layout tool. In particular, [img](#) elements should not be used to display transparent images, as such images rarely convey meaning and rarely add anything useful to the document.

What an [img](#) element represents depends on the [src](#) attribute and the [alt](#) attribute.

If the [src](#) attribute is set and the [alt](#) attribute is set to the empty string

The image is either decorative or supplemental to the rest of the content, redundant with some other information in the document.

If the image is [available](#) and the user agent is configured to display that image, then the element [represents](#) the element's image data.

Otherwise, the element [represents](#) nothing, and may be omitted completely from the rendering. User agents may provide the user with a notification that an image is present but has been omitted from the rendering.

If the [src](#) attribute is set and the [alt](#) attribute is set to a value that isn't empty

The image is a key part of the content; the [alt](#) attribute gives a textual equivalent or replacement for the image.

If the image is [available](#) and the user agent is configured to display that image, then the element [represents](#) the element's image data.

Otherwise, the element [represents](#) the text given by the [alt](#) attribute. User agents may

provide the user with a notification that an image is present but has been omitted from the rendering.

If the `src` attribute is set and the `alt` attribute is not

The image might be a key part of the content, and there is no textual equivalent of the image available.

In a conforming document, the absence of the `alt` attribute indicates that the image is a key part of the content but that a textual replacement for the image was not available when the image was generated.

If the image is [available](#) and the user agent is configured to display that image, then the element [represents](#) the element's image data.

If the image has a `src` attribute whose value is the empty string, then the element [represents](#) nothing.

Otherwise, the user agent should display some sort of indicator that there is an image that is not being rendered, and may, if requested by the user, or if so configured, or when required to provide contextual information in response to navigation, provide caption information for the image, derived as follows:

1. If the image has a `title` attribute whose value is not the empty string, then return the value of that attribute.
2. If the image is a descendant of a `figure` element that has a child `figcaption` element, and, ignoring the `figcaption` element and its descendants, the `figure` element has no [flow content](#) descendants other than [inter-element whitespace](#) and the `img` element, then return the contents of the first such `figcaption` element.
3. Return nothing. (There is no caption information.)

If the `src` attribute is not set and either the `alt` attribute is set to the empty string or the `alt` attribute is not set at all

The element [represents](#) nothing.

Otherwise

The element [represents](#) the text given by the `alt` attribute.

The `alt` attribute does not represent advisory information. User agents must not present the contents of the `alt` attribute in the same way as content of the `title` attribute.

User agents may always provide the user with the option to display any image, or to prevent any image from being displayed. User agents may also apply heuristics to help the user make use of the image when the user is unable to see it, e.g. due to a visual disability or because they

are using a text terminal with no graphics capabilities. Such heuristics could include, for instance, optical character recognition (OCR) of text found within the image.

While user agents are encouraged to repair cases of missing [alt](#) attributes, authors must not rely on such behavior. [Requirements for providing text to act as an alternative for images](#) are described in detail below.

The *contents* of [img](#) elements, if any, are ignored for the purposes of rendering.

The [usemap](#) attribute, if present, can indicate that the image has an associated [image map](#).

The [ismap](#) attribute, when used on an element that is a descendant of an [a](#) element with an [href](#) attribute, indicates by its presence that the element provides access to a server-side image map. This affects how events are handled on the corresponding [a](#) element.

The [ismap](#) attribute is a [boolean attribute](#). The attribute must not be specified on an element that does not have an ancestor [a](#) element with an [href](#) attribute.

The [usemap](#) and [ismap](#) attributes can result in confusing behavior when used together with [source](#) elements with the [media](#) attribute specified in a [picture](#) element.

The [img](#) element supports [dimension attributes](#).



[HTMLImageElement/alt](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLImageElement/src](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLImageElement/srcset](#)

Support in all current engines.

Firefox 38+ Safari 8+ Chrome 34+

Opera 21+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 38+ Safari iOS 8+ Chrome Android 34+ WebView Android 37+ Samsung Internet 2.0+ Opera Android No

[HTMLImageElement/sizes](#)

Support in all current engines.

Firefox 38+ Safari 9+ Chrome 38+

Opera 25+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 38+ Safari iOS 9+ Chrome Android 38+ WebView Android 38+ Samsung Internet 3.0+ Opera Android 25+

The *alt*, *src*, *srcset* and *sizes* IDL attributes must [reflect](#) the respective content attributes of the same name.



[HTMLImageElement/crossOrigin](#)

Support in all current engines.

Firefox 8+ Safari 6+ Chrome 13+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 8+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The *crossOrigin* IDL attribute must [reflect](#) the [*crossorigin*](#) content attribute, [limited to only known values](#).



[HTMLImageElement/useMap](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

The *useMap* IDL attribute must [reflect](#) the [*usemap*](#) content attribute.

✓MDN

[HTMLImageElement/isMap](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

The *isMap* IDL attribute must [reflect](#) the [*ismap*](#) content attribute.

✓MDN

[HTMLImageElement/referrerPolicy](#)

Support in all current engines.

Firefox50+Safari14+Chrome53+

Opera40+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android50+Safari iOS14+Chrome Android53+WebView Android53+Samsung

Internet6.0+Opera Android41+

The *referrerPolicy* IDL attribute must [reflect](#) the [*referrerpolicy*](#) content attribute, [limited to only known values](#).

✓MDN

[HTMLImageElement/decoding](#)

Support in all current engines.

Firefox63+Safari11.1+Chrome65+

Opera52+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS11.3+Chrome Android65+WebView Android65+Samsung

Internet9.0+ Opera Android47+

[SVGImageElement/decoding](#)

Firefox63+ SafariNoChrome65+

Opera52+ Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+ Safari iOSNoChrome Android65+ WebView Android65+Samsung
Internet9.0+ Opera Android47+

The *decoding* IDL attribute must [reflect](#) the *decoding* content attribute, [limited to only known values](#).

MDN

[HTMLImageElement/loading](#)

Firefox75+ SafariNoChrome77+

Opera64+ Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android79+ Safari iOSNoChrome Android77+ WebView Android77+Samsung
Internet12.0+ Opera Android55+

The *loading* IDL attribute must [reflect](#) the *loading* content attribute, [limited to only known values](#).

image.width [= value]

✓MDN

[HTMLImageElement/width](#)

Support in all current engines.

Firefox1+ Safari3+ Chrome1+

Opera12.1+ Edge79+

Edge (Legacy)12+ Internet Explorer5.5+

Firefox Android4+ Safari iOS1+ Chrome Android18+ WebView Android1+Samsung
Internet1.0+ Opera Android12.1+

image.height [= value]

✓MDN

[HTMLImageElement/height](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

These attributes return the actual rendered dimensions of the image, or zero if the dimensions are not known.

They can be set, to change the corresponding content attributes.

image.[naturalWidth](#)

✓MDN

[HTMLImageElement/naturalWidth](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

image.[naturalHeight](#)

✓MDN

[HTMLImageElement/naturalHeight](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

These attributes return the intrinsic dimensions of the image, or zero if the dimensions are not known.

image.[complete](#)

✓MDN

[HTMLImageElement/complete](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Returns true if the image has been completely downloaded or if no image is specified; otherwise, returns false.

image.[currentSrc](#)

✓MDN

[HTMLImageElement/currentSrc](#)

Support in all current engines.

Firefox38+Safari9+Chrome38+

Opera25+Edge79+

Edge (Legacy)13+Internet ExplorerNo

Firefox Android38+Safari iOS9+Chrome Android38+WebView Android38+Samsung Internet3.0+Opera Android25+

Returns the image's [absolute URL](#).

image.[decode\(\)](#)

✓MDN

[HTMLImageElement/decode](#)

Support in all current engines.

Firefox68+Safari11.1+Chrome64+

Opera51+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android68+Safari iOS11.3+Chrome Android64+WebView Android64+Samsung Internet9.0+Opera Android47+

[SVGImageElement/decode](#)

Support in one engine only.

FirefoxNoSafariNoChrome65+

Opera52+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOSNoChrome Android65+WebView Android65+Samsung

Internet9.0+Opera Android47+

This method causes the user agent to [decode](#) the image [in parallel](#), returning a promise that fulfills when decoding is complete.

The promise will be rejected with an "[EncodingException](#)" [DOMException](#) if the image cannot be decoded.

`image = new Image([width [, height]])`

✓MDN

[HTMLImageElement/Image](#)

Support in all current engines.

Firefox1+Safari4+Chrome1+

Opera8+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android?

Returns a new [img](#) element, with the [width](#) and [height](#) attributes set to the values passed in the relevant arguments, if applicable.

The IDL attributes [*width*](#) and [*height*](#) must return the rendered width and height of the image, in [CSS pixels](#), if the image is [being rendered](#), and is being rendered to a visual medium; or else the [density-corrected intrinsic width and height](#) of the image, in [CSS pixels](#), if the image has [intrinsic dimensions](#) and is [available](#) but not being rendered to a visual medium; or else 0, if the image is not [available](#) or does not have [intrinsic dimensions](#). [\[CSS\]](#)

On setting, they must act as if they [reflected](#) the respective content attributes of the same name.

The IDL attributes [*naturalWidth*](#) and [*naturalHeight*](#) must return the [density-corrected intrinsic width and height](#) of the image, in [CSS pixels](#), if the image has [intrinsic dimensions](#) and is [available](#), or else 0. [\[CSS\]](#)

Since the [intrinsic dimensions](#) of an image take into account any orientation specified in its metadata, [*naturalWidth*](#) and [*naturalHeight*](#) reflect the dimensions after applying any rotation needed to correctly orient the image, regardless of the value of the ['image-orientation'](#) property.

The IDL attribute [*complete*](#) must return true if any of the following conditions is true:

- Both the [*src*](#) attribute and the [*srcset*](#) attribute are omitted.
- The [*srcset*](#) attribute is omitted and the [*src*](#) attribute's value is the empty string.
- The [img](#) element's [current request's state](#) is [completely available](#) and its [pending](#)

[request](#) is null.

- The [img](#) element's [current request's state](#) is [broken](#) and its [pending request](#) is null.

Otherwise, the attribute must return false.

The [currentSrc](#) IDL attribute must return the [img](#) element's [current request's current URL](#).

The [decode\(\)](#) method, when invoked, must perform the following steps:

1. Let *promise* be a new promise.
2. [Queue a microtask](#) to perform the following steps:

This is done because [updating the image data](#) takes place in a microtask as well. Thus, to make code such as

```
img.src = "stars.jpg";
img.decode();
```

properly decode `stars.jpg`, we need to delay any processing by one microtask.

1. If any of the following conditions are true about this [img](#) element:
 - its [node document](#) is not an [active document](#);
 - its [current request's state](#) is [broken](#),then reject *promise* with an ["EncodingException" DOMException](#).
2. Otherwise, [in parallel](#), wait for one of the following cases to occur, and perform the corresponding actions:

This [img](#) element's [node document](#) stops being an [active document](#)

This [img](#) element's [current request](#) changes or is mutated

This [img](#) element's [current request's state](#) becomes [broken](#)

Reject *promise* with an ["EncodingException" DOMException](#).

This [img](#) element's [current request's state](#) becomes [completely available](#)

[Decode](#) the image.

If decoding does not need to be performed for this image (for example because it is a vector graphic), resolve *promise* with undefined.

If decoding fails (for example due to invalid image data), reject *promise* with an ["EncodingException" DOMException](#).

If the decoding process completes successfully, resolve *promise* with undefined.

User agents should ensure that the decoded media data stays readily available until at least the end of the next successful [update the rendering step in the event loop](#). This is an important part of the API contract, and should not be broken if at all possible. (Typically, this would only be violated in low-memory situations that require evicting decoded image data, or when the image is too large to keep in decoded form for this period of time.)

Animated images will become [completely available](#) only after all their frames are loaded. Thus, even though an implementation could decode the first frame before that point, the above steps will not do so, instead waiting until all frames are available.

3. Return *promise*.

Without the [decode\(\)](#) method, the process of loading an [img](#) element and then displaying it might look like the following:

```
const img = new Image();
img.src = "nebula.jpg";
img.onload = () => {
    document.body.appendChild(img);
};
img.onerror = () => {
    document.body.appendChild(new Text("Could not load the nebula :("));
};
```

However, this can cause notable dropped frames, as the paint that occurs after inserting the image into the DOM causes a synchronous decode on the main thread.

This can instead be rewritten using the [decode\(\)](#) method:

```
const img = new Image();
img.src = "nebula.jpg";
img.decode().then(() => {
    document.body.appendChild(img);
}).catch(() => {
    document.body.appendChild(new Text("Could not load the nebula :("));
});
```

This latter form avoids the dropped frames of the original, by allowing the user agent to decode the image [in parallel](#), and only inserting it into the DOM (and thus causing it to be painted) once the decoding process is complete.

Because the [decode\(\)](#) method attempts to ensure that the decoded image data is available for

at least one frame, it can be combined with the [requestAnimationFrame\(\)](#) API. This means it can be used with coding styles or frameworks that ensure that all DOM modifications are batched together as [animation frame callbacks](#):

```
const container = document.querySelector("#container");

const { containerWidth, containerHeight } = computeDesiredSize();
requestAnimationFrame(() => {
  container.style.width = containerWidth;
  container.style.height = containerHeight;
});

// ...

const img = new Image();
img.src = "supernova.jpg";
img.decode().then(() => {
  requestAnimationFrame(() => container.appendChild(img));
});
```

A legacy factory function is provided for creating [HTMLImageElement](#) objects (in addition to the factory methods from DOM such as [createElement\(\)](#): *Image(width, height)*). When invoked, the legacy factory function must perform the following steps:

1. Let *document* be the [current global object](#)'s [associated Document](#).
2. Let *img* be the result of [creating an element](#) given *document*, *img*, and the [HTML namespace](#).
3. If *width* is given, then [set an attribute value](#) for *img* using "[width](#)" and *width*.
4. If *height* is given, then [set an attribute value](#) for *img* using "[height](#)" and *height*.
5. Return *img*.

A single image can have different appropriate alternative text depending on the context.

In each of the following cases, the same image is used, yet the [alt](#) text is different each time. The image is the coat of arms of the Carouge municipality in the canton Geneva in Switzerland.

Here it is used as a supplementary icon:

```
<p>I lived in  Carouge.</p>
```

Here it is used as an icon representing the town:

```
<p>Home town: </p>
```

Here it is used as part of a text on the town:

```
<p>Carouge has a coat of arms.</p>
<p></p>
<p>It is used as decoration all over the town.</p>
```

Here it is used as a way to support a similar text where the description is given as well as, instead of as an alternative to, the image:

```
<p>Carouge has a coat of arms.</p>
<p></p>
<p>The coat of arms depicts a lion, sitting in front of a tree.  
It is used as decoration all over the town.</p>
```

Here it is used as part of a story:

```
<p>She picked up the folder and a piece of paper fell out.</p>
<p></p>
<p>She stared at the folder. S! The answer she had been looking for all this time was simply the letter S! How had she not seen that before? It all came together now. The phone call where Hector had referred to a lion's tail, the time Maria had stuck her tongue out...</p>
```

Here it is not known at the time of publication what the image will be, only that it will be a coat of arms of some kind, and thus no replacement text can be provided, and instead only a brief caption for the image is provided, in the [title](#) attribute:

```
<p>The last user to have uploaded a coat of arms uploaded this one:</p>
<p></p>
```

Ideally, the author would find a way to provide real replacement text even in this case, e.g. by asking the previous user. Not providing replacement text makes the document more difficult to use for people who are unable to view images, e.g. blind users, or users on very low-bandwidth connections or who pay by the byte, or users who are forced to use a text-only web browser.

Here are some more examples showing the same picture used in different contexts, with different appropriate alternate texts each time.

```
<article>
  <h1>My cats</h1>
  <h2>Fluffy</h2>
  <p>Fluffy is my favorite.</p>
  
  <p>She's just too cute.</p>
  <h2>Miles</h2>
  <p>My other cat, Miles just eats and sleeps.</p>
```

```

</article>

<article>
  <h1>Photography</h1>
  <h2>Shooting moving targets indoors</h2>
  <p>The trick here is to know how to anticipate; to know at what speed and what distance the subject will pass by.</p>
  
  <h2>Nature by night</h2>
  <p>To achieve this, you'll need either an extremely sensitive film, or immense flash lights.</p>
</article>

<article>
  <h1>About me</h1>
  <h2>My pets</h2>
  <p>I've got a cat named Fluffy and a dog named Miles.</p>
  
  <p>My dog Miles and I like go on long walks together.</p>
  <h2>music</h2>
  <p>After our walks, having emptied my mind, I like listening to Bach.</p>
</article>

<article>
  <h1>Fluffy and the Yarn</h1>
  <p>Fluffy was a cat who liked to play with yarn. She also liked to jump.</p>
  <aside></aside>
  <p>She would play in the morning, she would play in the evening.</p>
</article>

```

4.8.4 Images

4.8.4.1 Introduction

This section is non-normative.

To embed an image in HTML, when there is only a single image resource, use the [img](#) element and its [src](#) attribute.

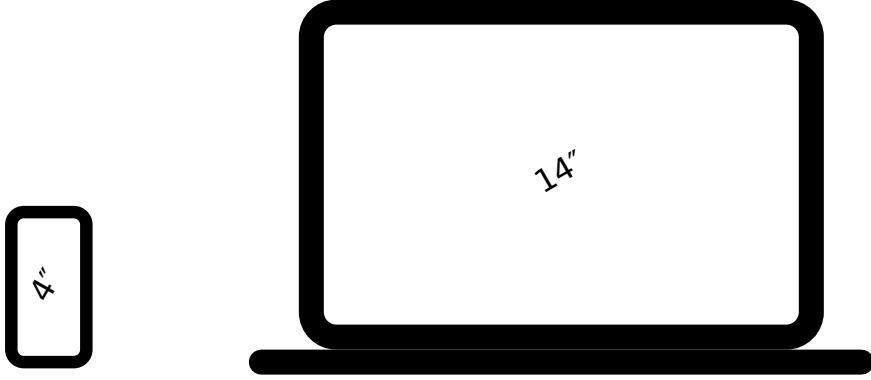
```

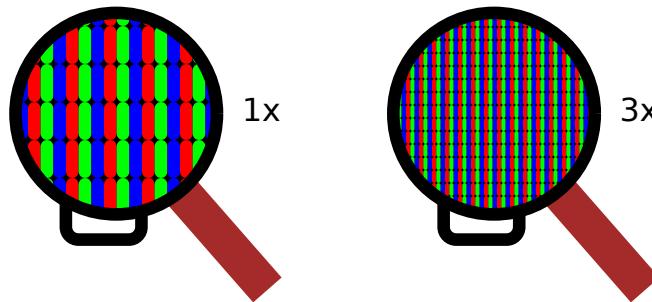
<h2>From today's featured article</h2>

<p><b><a href="/wiki/Marie_Lloyd">Marie Lloyd</a></b> (1870–1922) was an English <a href="/wiki/Music_hall">music hall</a> singer, ...

```

However, there are a number of situations for which the author might wish to use multiple image resources that the user agent can choose from:

- Different users might have different environmental characteristics:
 - The users' physical screen size might be different from one another.
A mobile phone's screen might be 4 inches diagonally, while a laptop's screen might be 14 inches diagonally.
- 
- This diagram illustrates the difference in physical screen size between a mobile phone and a laptop. On the left, a small smartphone icon is labeled '4'' to indicate its 4-inch diagonal screen size. On the right, a larger laptop icon is labeled '14'' to indicate its 14-inch diagonal screen size.
- The users' screen pixel density might be different from one another.
A mobile phone's screen might have three times as many physical pixels per inch compared to another mobile phone's screen, regardless of their physical screen size.

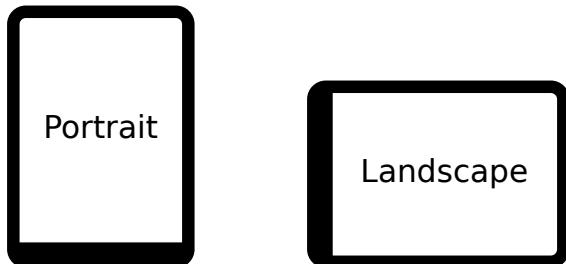


- The users' zoom level might be different from one another, or might change for a single user over time.
A user might zoom in to a particular image to be able to get a more detailed look.

The zoom level and the screen pixel density (the previous point) can both affect the number of physical screen pixels per [CSS pixel](#). This ratio is usually referred to as *device-pixel-ratio*.

- The users' screen orientation might be different from one another, or might change for a single user over time.

A tablet can be held upright or rotated 90 degrees, so that the screen is either "portrait" or "landscape".

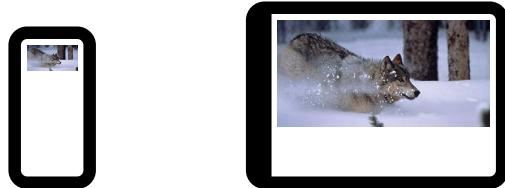


- The users' network speed, network latency and bandwidth cost might be different from one another, or might change for a single user over time.

A user might be on a fast, low-latency and constant-cost connection while at work, on a slow, low-latency and constant-cost connection while at home, and on a variable-speed, high-latency and variable-cost connection anywhere else.

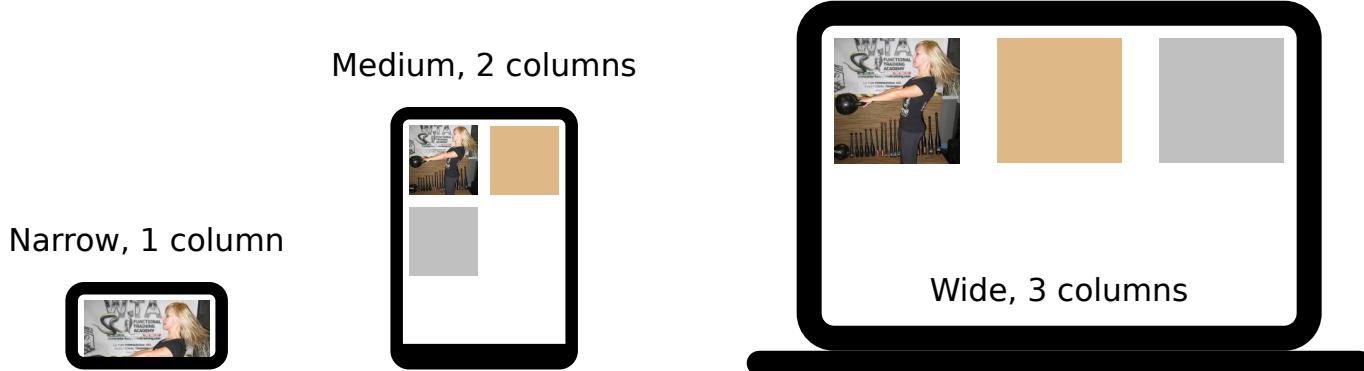
- Authors might want to show the same image content but with different rendered size depending on, usually, the width of the [viewport](#). This is usually referred to as *viewport-based selection*.

A web page might have a banner at the top that always spans the entire [viewport](#) width. In this case, the rendered size of the image depends on the physical size of the screen (assuming a maximised browser window).



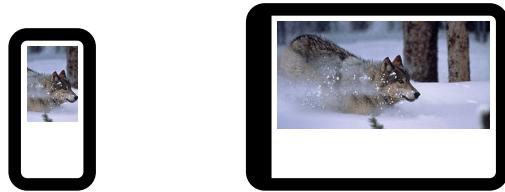
Another web page might have images in columns, with a single column for screens with a small physical size, two columns for screens with medium physical size, and three columns for screens with big physical size, with the images varying in rendered size in each case to fill up the [viewport](#). In this case, the rendered size of an image might be *bigger* in the one-column layout compared to the two-column layout, despite the screen

being smaller.



- Authors might want to show different image content depending on the rendered size of the image. This is usually referred to as *art direction*.

When a web page is viewed on a screen with a large physical size (assuming a maximised browser window), the author might wish to include some less relevant parts surrounding the critical part of the image. When the same web page is viewed on a screen with a small physical size, the author might wish to show only the critical part of the image.



- Authors might want to show the same image content but using different image formats, depending on which image formats the user agent supports. This is usually referred to as *image format-based selection*.

A web page might have some images in the JPEG, WebP and JPEG XR image formats, with the latter two having better compression abilities compared to JPEG. Since different user agents can support different image formats, with some formats offering better compression ratios, the author would like to serve the better formats to user agents that support them, while providing JPEG fallback for user agents that don't.

The above situations are not mutually exclusive. For example, it is reasonable to combine different resources for different [device-pixel-ratio](#) with different resources for [art direction](#).

While it is possible to solve these problems using scripting, doing so introduces some other problems:

- Some user agents aggressively download images specified in the HTML markup, before scripts have had a chance to run, so that web pages complete loading sooner. If a script changes which image to download, the user agent will potentially start two separate downloads, which can instead cause worse page loading performance.
- If the author avoids specifying any image in the HTML markup and instead instantiates a single download from script, that avoids the double download problem above but then no image will be downloaded at all for users with scripting disabled and the aggressive image downloading optimization will also be disabled.

With this in mind, this specification introduces a number of features to address the above problems in a declarative manner.

Device-pixel-ratio-based selection when the rendered size of the image is fixed

The `src` and `srcset` attributes on the `img` element can be used, using the `x` descriptor, to provide multiple images that only vary in their size (the smaller image is a scaled-down version of the bigger image).

The `x` descriptor is not appropriate when the rendered size of the image depends on the `viewport` width ([viewport-based selection](#)), but can be used together with [art direction](#).

```
<h2>From today's featured article</h2>

<p><b><a href="/wiki/Marie_Lloyd">Marie Lloyd</a></b> (1870–1922)
was an English <a href="/wiki/Music_hall">music hall</a> singer, ...
```

The user agent can choose any of the given resources depending on the user's screen's pixel density, zoom level, and possibly other factors such as the user's network conditions.

For backwards compatibility with older user agents that don't yet understand the `srcset` attribute, one of the URLs is specified in the `img` element's `src` attribute. This will result in something useful (though perhaps lower-resolution than the user would like) being displayed even in older user agents. For new user agents, the `src` attribute participates in the resource selection, as if it was specified in `srcset` with a `1x` descriptor.

The image's rendered size is given in the `width` and `height` attributes, which allows the user agent to allocate space for the image before it is downloaded.

Viewport-based selection

The `srcset` and `sizes` attributes can be used, using the `w` descriptor, to provide multiple images that only vary in their size (the smaller image is a scaled-down version of the bigger image).

In this example, a banner image takes up the entire [viewport](#) width (using appropriate CSS).

```
<h1></h1>
```

The user agent will calculate the effective pixel density of each image from the specified `w` descriptors and the specified rendered size in the [sizes](#) attribute. It can then choose any of the given resources depending on the user's screen's pixel density, zoom level, and possibly other factors such as the user's network conditions.

If the user's screen is 320 [CSS pixels](#) wide, this is equivalent to specifying `wolf-400.jpg 1.25x`, `wolf-800.jpg 2.5x`, `wolf-1600.jpg 5x`. On the other hand, if the user's screen is 1200 [CSS pixels](#) wide, this is equivalent to specifying `wolf-400.jpg 0.33x`, `wolf-800.jpg 0.67x`, `wolf-1600.jpg 1.33x`. By using the `w` descriptors and the [sizes](#) attribute, the user agent can choose the correct image source to download regardless of how large the user's device is.

For backwards compatibility, one of the URLs is specified in the [img](#) element's [src](#) attribute. In new user agents, the [src](#) attribute is ignored when the [srcset](#) attribute uses `w` descriptors.

In this example, the web page has three layouts depending on the width of the [viewport](#). The narrow layout has one column of images (the width of each image is about 100%), the middle layout has two columns of images (the width of each image is about 50%), and the widest layout has three columns of images, and some page margin (the width of each image is about 33%). It breaks between these layouts when the [viewport](#) is `30em` wide and `50em` wide, respectively.

```

```

The [sizes](#) attribute sets up the layout breakpoints at `30em` and `50em`, and declares the image sizes between these breakpoints to be `100vw`, `50vw`, or `calc(33vw - 100px)`. These sizes do not necessarily have to match up exactly with the actual image width as specified in the CSS.

The user agent will pick a width from the [sizes](#) attribute, using the first item with a [<media-condition>](#) (the part in parentheses) that evaluates to true, or using the last item (`calc(33vw - 100px)`) if they all evaluate to false.

For example, if the [viewport](#) width is `29em`, then `(max-width: 30em)` evaluates to true and `100vw` is used, so the image size, for the purpose of resource selection, is `29em`. If the [viewport](#) width is instead `32em`, then `(max-width: 30em)` evaluates to false, but `(max-width: 50em)` evaluates to true and `50vw` is used, so the image size, for the purpose of resource selection, is `16em` (half the [viewport](#) width). Notice that the slightly wider

[viewport](#) results in a smaller image because of the different layout.

The user agent can then calculate the effective pixel density and choose an appropriate resource similarly to the previous example.

[Art direction](#)-based selection

The [picture](#) element and the [source](#) element, together with the [media](#) attribute, can be used to provide multiple images that vary the image content (for instance the smaller image might be a cropped version of the bigger image).

```
<picture>
  <source media="(min-width: 45em)" srcset="large.jpg">
  <source media="(min-width: 32em)" srcset="med.jpg">
  
</picture>
```

The user agent will choose the first [source](#) element for which the media query in the [media](#) attribute matches, and then choose an appropriate URL from its [srcset](#) attribute.

The rendered size of the image varies depending on which resource is chosen. To specify dimensions that the user agent can use before having downloaded the image, CSS can be used.

```
img { width: 300px; height: 300px }
@media (min-width: 32em) { img { width: 500px; height: 300px } }
@media (min-width: 45em) { img { width: 700px; height: 400px } }
```

This example combines [art direction](#)- and [device-pixel-ratio](#)-based selection. A banner that takes half the [viewport](#) is provided in two versions, one for wide screens and one for narrow screens.

```
<h1>
  <picture>
    <source media="(max-width: 500px)" srcset="banner-phone.jpeg, banner-pho
      
  </h1>
```

[Image format](#)-based selection

The [type](#) attribute on the [source](#) element can be used to provide multiple images in different formats.

```
<h2>From today's featured article</h2>
<picture>
  <source srcset="/uploads/100-marie-lloyd.webp" type="image/webp">
  <source srcset="/uploads/100-marie-lloyd.jxr" type="image/vnd.ms-photo">
```

```

</picture>
<p><b><a href="/wiki/Marie_Lloyd">Marie Lloyd</a></b> (1870–1922)
was an English <a href="/wiki/Music_hall">music hall</a> singer, ...
```

In this example, the user agent will choose the first source that has a [type](#) attribute with a supported MIME type. If the user agent supports WebP images, the first [source](#) element will be chosen. If not, but the user agent does support JPEG XR images, the second [source](#) element will be chosen. If neither of those formats are supported, the [img](#) element will be chosen.

4.8.4.1.1 Adaptive images

This section is non-normative.

CSS and media queries can be used to construct graphical page layouts that adapt dynamically to the user's environment, in particular to different [viewport](#) dimensions and pixel densities. For content, however, CSS does not help; instead, we have the [img](#) element's [srcset](#) attribute and the [picture](#) element. This section walks through a sample case showing how to use these features.

Consider a situation where on wide screens (wider than 600 [CSS pixels](#)) a 300×150 image named `a-rectangle.png` is to be used, but on smaller screens (600 [CSS pixels](#) and less), a smaller 100×100 image called `a-square.png` is to be used. The markup for this would look like this:

```
<figure>
  <picture>
    <source srcset="a-square.png" media="(max-width: 600px)">
      
    </picture>
    <figcaption>Barney Frank, 2011</figcaption>
  </figure>
```

For details on what to put in the [alt](#) attribute, see the [Requirements for providing text to act as an alternative for images](#) section.

The problem with this is that the user agent does not necessarily know what dimensions to use for the image when the image is loading. To avoid the layout having to be reflowed multiple times as the page is loading, CSS and CSS media queries can be used to provide the dimensions:

```
<style>
  #a { width: 300px; height: 150px; }
  @media (max-width: 600px) { #a { width: 100px; height: 100px; } }
</style>
<figure>
  <picture>
```

```
<source srcset="a-square.png" media="(max-width: 600px)">

</picture>
<figcaption>Barney Frank, 2011</figcaption>
</figure>
```

Alternatively, the [width](#) and [height](#) attributes can be used to provide the width and height for legacy user agents, using CSS just for the user agents that support [picture](#):

```
<style media="(max-width: 600px)">
#a { width: 100px; height: 100px; }
</style>
<figure>
<picture>
<source srcset="a-square.png" media="(max-width: 600px)">

</picture>
<figcaption>Barney Frank, 2011</figcaption>
</figure>
```

The [img](#) element is used with the [src](#) attribute, which gives the URL of the image to use for legacy user agents that do not support the [picture](#) element. This leads to a question of which image to provide in the [src](#) attribute.

If the author wants the biggest image in legacy user agents, the markup could be as follows:

```
<picture>
<source srcset="pear-mobile.jpeg" media="(max-width: 720px)">
<source srcset="pear-tablet.jpeg" media="(max-width: 1280px)">

</picture>
```

However, if legacy mobile user agents are more important, one can list all three images in the [source](#) elements, overriding the [src](#) attribute entirely.

```
<picture>
<source srcset="pear-mobile.jpeg" media="(max-width: 720px)">
<source srcset="pear-tablet.jpeg" media="(max-width: 1280px)">
<source srcset="pear-desktop.jpeg">

</picture>
```

Since at this point the [src](#) attribute is actually being ignored entirely by [picture](#)-supporting user agents, the [src](#) attribute can default to any image, including one that is neither the smallest nor biggest:

```
<picture>
  <source srcset="pear-mobile.jpeg" media="(max-width: 720px)">
  <source srcset="pear-tablet.jpeg" media="(max-width: 1280px)">
  <source srcset="pear-desktop.jpeg">
  
</picture>
```

Above the **max-width** media feature is used, giving the maximum ([viewport](#)) dimensions that an image is intended for. It is also possible to use **min-width** instead.

```
<picture>
  <source srcset="pear-desktop.jpeg" media="(min-width: 1281px)">
  <source srcset="pear-tablet.jpeg" media="(min-width: 721px)">
  
</picture>
```

4.8.4.2 Attributes common to [source](#), [img](#), and [link](#) elements

4.8.4.2.1 Srcset attributes

A *srcset attribute* is an attribute with requirements defined in this section.

If present, its value must consist of one or more [image candidate strings](#), each separated from the next by a U+002C COMMA character (,). If an [image candidate string](#) contains no descriptors and no [ASCII whitespace](#) after the URL, the following [image candidate string](#), if there is one, must begin with one or more [ASCII whitespace](#).

An *image candidate string* consists of the following components, in order, with the further restrictions described below this list:

1. Zero or more [ASCII whitespace](#).
2. A [valid non-empty URL](#) that does not start or end with a U+002C COMMA character (,), referencing a non-interactive, optionally animated, image resource that is neither paged nor scripted.
3. Zero or more [ASCII whitespace](#).
4. Zero or one of the following:
 - A *width descriptor*, consisting of: [ASCII whitespace](#), a [valid non-negative integer](#) giving a number greater than zero representing the *width descriptor value*, and a U+0077 LATIN SMALL LETTER W character.
 - A *pixel density descriptor*, consisting of: [ASCII whitespace](#), a [valid floating-point number](#) giving a number greater than zero representing the *pixel density*

descriptor value, and a U+0078 LATIN SMALL LETTER X character.

5. Zero or more [ASCII whitespace](#).

There must not be an [image candidate string](#) for an element that has the same [width descriptor value](#) as another [image candidate string's width descriptor value](#) for the same element.

There must not be an [image candidate string](#) for an element that has the same [pixel density descriptor value](#) as another [image candidate string's pixel density descriptor value](#) for the same element. For the purpose of this requirement, an [image candidate string](#) with no descriptors is equivalent to an [image candidate string](#) with a `1x` descriptor.

If an [image candidate string](#) for an element has the [width descriptor](#) specified, all other [image candidate strings](#) for that element must also have the [width descriptor](#) specified.

The specified width in an [image candidate string's width descriptor](#) must match the [intrinsic width](#) in the resource given by the [image candidate string's URL](#), if it has an [intrinsic width](#).

If an element has a [sizes attribute](#) present, all [image candidate strings](#) for that element must have the [width descriptor](#) specified.

4.8.4.2.2 Sizes attributes

A *sizes attribute* is an attribute with requirements defined in this section.

If present, the value must be a [valid source size list](#).

A *valid source size list* is a string that matches the following grammar: [\[CSSVALUES\]](#) [\[MQ\]](#)

```
<source-size-list> = [ <source-size># , ]? <source-size-value>
<source-size> = <media-condition> <source-size-value>
<source-size-value> = <length>
```

A [<source-size-value>](#) must not be negative, and must not use CSS functions other than the [math functions](#).

The [<source-size-value>](#) gives the intended layout width of the image. The author can specify different widths for different environments with [<media-condition>](#)s.

Percentages are not allowed in a [<source-size-value>](#), to avoid confusion about what it would be relative to. The ['vw'](#) unit can be used for sizes relative to the [viewport](#) width.

4.8.4.3 Processing model

An [img](#) element has a *current request* and a *pending request*. The [current request](#) is initially set to a new [image request](#). The [pending request](#) is initially set to null.

An *image request* has a *state*, *current URL*, and *image data*.

An [image request's state](#) is one of the following:

Unavailable

The user agent hasn't obtained any image data, or has obtained some or all of the image data but hasn't yet decoded enough of the image to get the image dimensions.

Partially available

The user agent has obtained some of the image data and at least the image dimensions are available.

Completely available

The user agent has obtained all of the image data and at least the image dimensions are available.

Broken

The user agent has obtained all of the image data that it can, but it cannot even decode the image enough to get the image dimensions (e.g. the image is corrupted, or the format is not supported, or no data could be obtained).

An [image request's current URL](#) is initially the empty string.

An [image request's image data](#) is the decoded image data.

When an [image request's state](#) is either [partially available](#) or [completely available](#), the [image request](#) is said to be *available*.

When an [img element's current request's state](#) is [completely available](#) and the user agent can decode the media data without errors, then the [img element](#) is said to be *fully decodable*.

An [image request's state](#) is initially [unavailable](#).

When an [img element's current request](#) is [available](#), the [img element](#) provides a [paint source](#) whose width is the image's [density-corrected intrinsic width](#) (if any), whose height is the image's [density-corrected intrinsic height](#) (if any), and whose appearance is the intrinsic appearance of the image.

An [img element](#) is said to *use srcset or picture* if it has a [srcset](#) attribute specified or if it has a parent that is a [picture element](#).

Each [img element](#) has a *last selected source*, which must initially be null.

Each [image request](#) has a *current pixel density*, which must initially be 1.

Each [image request](#) has *preferred density-corrected dimensions*, which is either a struct

consisting of a width and a height or is null. It must initially be null.

To determine the *density-corrected intrinsic width and height* of an [img](#) element *img*:

1. Let *dim* be *img*'s [current request](#)'s [preferred density-corrected dimensions](#).
2. If *dim* is null, set *dim* to *img*'s [intrinsic dimensions](#).
3. Set *dim*'s width to *dim*'s width divided by *img*'s [current request](#)'s [current pixel density](#).
4. Set *dim*'s height to *dim*'s height divided by *img*'s [current request](#)'s [current pixel density](#).
5. Return *dim*.

For example, if the [current pixel density](#) is 3.125, that means that there are 300 device pixels per [CSS inch](#), and thus if the image data is 300x600, it has [intrinsic dimensions](#) of 96 [CSS pixels](#) by 192 [CSS pixels](#).

All [img](#) and [link](#) elements are associated with a [source set](#).

A [source set](#) is an ordered set of zero or more [image sources](#) and a [source size](#).

An [image source](#) is a [URL](#), and optionally either a [pixel density descriptor](#), or a [width descriptor](#).

A [source size](#) is a [`<source-size-value>`](#). When a [source size](#) has a unit relative to the [viewport](#), it must be interpreted relative to the [img](#) element's [node document](#)'s [viewport](#). Other units must be interpreted the same as in Media Queries. [\[MQ\]](#)

A *parse error* for algorithms in this section indicates a non-fatal mismatch between input and requirements. User agents are encouraged to expose [parse errors](#) somehow.

Whether the image is fetched successfully or not (e.g. whether the response status was an [ok status](#)) must be ignored when determining the image's type and whether it is a valid image.

This allows servers to return images with error responses, and have them displayed.

The user agent should apply the [image sniffing rules](#) to determine the type of the image, with the image's [associated Content-Type headers](#) giving the *official type*. If these rules are not applied, then the type of the image must be the type given by the image's [associated Content-Type headers](#).

User agents must not support non-image resources with the [img](#) element (e.g. XML files whose [document element](#) is an HTML element). User agents must not run executable code (e.g. scripts) embedded in the image resource. User agents must only display the first page of a multipage resource (e.g. a PDF file). User agents must not allow the resource to act in an interactive

fashion, but should honour any animation in the resource.

This specification does not specify which image types are to be supported.

4.8.4.3.1 When to obtain images

By default, images are obtained immediately. User agents may provide users with the option to instead obtain them on-demand. (The on-demand option might be used by bandwidth-constrained users, for example.)

When obtaining images immediately, the user agent must synchronously [update the image data](#) of the [img](#) element, with the *restart animation* flag set if so stated, whenever that element is created or has experienced [relevant mutations](#).

When obtaining images on demand, the user agent must [update the image data](#) of an [img](#) element whenever it needs the image data (i.e., on demand), but only if the [img](#) element's *current request's state* is [unavailable](#). When an [img](#) element has experienced [relevant mutations](#), if the user agent only obtains images on demand, the [img](#) element's *current request's state* must return to [unavailable](#).

4.8.4.3.2 Reacting to DOM mutations

The *relevant mutations* for an [img](#) element are as follows:

- The element's [src](#), [srcset](#), [width](#), or [sizes](#) attributes are set, changed, or removed.
- The element's [src](#) attribute is set to the same value as the previous value. This must set the *restart animation* flag for the [update the image data](#) algorithm.
- The element's [crossorigin](#) attribute's state is changed.
- The element's [referrerpolicy](#) attribute's state is changed.
- The [element is inserted](#) into or [removed](#) from a [picture](#) parent element.
- The element's parent is a [picture](#) element and a [source element is inserted](#) as a previous sibling.
- The element's parent is a [picture](#) element and a [source](#) element that was a previous sibling is [removed](#).
- The element's parent is a [picture](#) element and a [source](#) element that is a previous sibling has its [srcset](#), [sizes](#), [media](#), [type](#), [width](#) or [height](#) attributes set, changed, or removed.
- The element's [adopting steps](#) are run.

4.8.4.3.3 The list of available images

Each [Document](#) object must have a *list of available images*. Each image in this list is identified by a tuple consisting of an [absolute URL](#), a [CORS settings attribute](#) mode, and, if the mode is not [No CORS](#), an [origin](#). Each image furthermore has an [ignore higher-layer caching](#) flag. User agents may copy entries from one [Document](#) object's [list of available images](#) to another at any time (e.g. when the [Document](#) is created, user agents can add to it all the images that are loaded in other [Document](#)s), but must not change the keys of entries copied in this way when doing so, and must unset the [ignore higher-layer caching](#) flag for the copied entry. User agents may also remove images from such lists at any time (e.g. to save memory). User agents must remove entries in the [list of available images](#) as appropriate given higher-layer caching semantics for the resource (e.g. the HTTP '[Cache-Control](#)' response header) when the [ignore higher-layer caching](#) flag is unset.

The [list of available images](#) is intended to enable synchronous switching when changing the [src](#) attribute to a URL that has previously been loaded, and to avoid re-downloading images in the same document even when they don't allow caching per HTTP. It is not used to avoid re-downloading the same image while the previous image is still loading.

The user agent can also store the image data separately from the [list of available images](#).

For example, if a resource has the HTTP response header '[Cache-Control: must-revalidate](#)', and its [ignore higher-layer caching](#) flag is unset, the user agent would remove it from the [list of available images](#) but could keep the image data separately, and use that if the server responds with a [304 Not Modified](#) status.

4.8.4.3.4 Decoding images

Image data is usually encoded in order to reduce file size. This means that in order for the user agent to present the image to the screen, the data needs to be decoded. *Decoding* is the process which converts an image's media data into a bitmap form, suitable for presentation to the screen. Note that this process can be slow relative to other processes involved in presenting content. Thus, the user agent can choose when to perform decoding, in order to create the best user experience.

Image decoding is said to be synchronous if it prevents presentation of other content until it is finished. Typically, this has an effect of atomically presenting the image and any other content at the same time. However, this presentation is delayed by the amount of time it takes to perform the decode.

Image decoding is said to be asynchronous if it does not prevent presentation of other content. This has an effect of presenting non-image content faster. However, the image content is missing on screen until the decode finishes. Once the decode is finished, the screen is updated with the image.

In both synchronous and asynchronous decoding modes, the final content is presented to screen

after the same amount of time has elapsed. The main difference is whether the user agent presents non-image content ahead of presenting the final content.

In order to aid the user agent in deciding whether to perform synchronous or asynchronous decode, the [decoding](#) attribute can be set on [img](#) elements. The possible values of the [decoding](#) attribute are the following *image decoding hint* keywords:

Keyword	State	Description
<code>sync</code>	<code>Sync</code>	Indicates a preference to decode this image synchronously for atomic presentation with other content.
<code>async</code>	<code>Async</code>	Indicates a preference to decode this image asynchronously to avoid delaying presentation of other content.
<code>auto</code>	<code>Auto</code>	Indicates no preference in decoding mode (the default).

When [decoding](#) an image, the user agent should respect the preference indicated by the [decoding](#) attribute's state. If the state indicated is [auto](#), then the user agent is free to choose any decoding behavior.

It is also possible to control the decoding behavior using the [decode\(\)](#) method. Since the [decode\(\)](#) method performs [decoding](#) independently from the process responsible for presenting content to screen, it is unaffected by the [decoding](#) attribute.

4.8.4.3.5 Updating the image data

This algorithm cannot be called from steps running [in parallel](#). If a user agent needs to call this algorithm from steps running [in parallel](#), it needs to [queue](#) a task to do so.

When the user agent is to *update the image data* of an [img](#) element, optionally with the *restart animations* flag set, it must run the following steps:

1. If the element's [node document](#) is not the [active document](#), then:
 1. Continue running this algorithm [in parallel](#).
 2. Wait until the element's [node document](#) is the [active document](#).
 3. If another instance of this algorithm for this [img](#) element was started after this instance (even if it aborted and is no longer running), then return.
 4. [Queue a microtask](#) to continue this algorithm.
2. If the user agent cannot support images, or its support for images has been disabled, then [abort the image request](#) for the [current request](#) and the [pending request](#), set [current request's state](#) to [unavailable](#), set [pending request](#) to null, and return.
3. Let *selected source* be null and *selected pixel density* be undefined.

4. If the element does not [use `srcset` or `picture`](#) and it has a [`src`](#) attribute specified whose value is not the empty string, then set *selected source* to the value of the element's [`src`](#) attribute and set *selected pixel density* to 1.0.
5. Set the element's [last selected source](#) to *selected source*.
6. If *selected source* is not null, then:
 1. [Parse *selected source*](#), relative to the element's [node document](#). If that is not successful, then abort this inner set of steps. Otherwise, let *urlString* be the [resulting URL string](#).
 2. Let *key* be a tuple consisting of *urlString*, the [`img`](#) element's [`crossorigin`](#) attribute's mode, and, if that mode is not [No CORS](#), the [node document's origin](#).
 3. If the [list of available images](#) contains an entry for *key*, then:
 1. Set the [ignore higher-layer caching](#) flag for that entry.
 2. [Abort the image request](#) for the [current request](#) and the [pending request](#).
 3. Set [pending request](#) to null.
 4. Let [current request](#) be a new [image request](#) whose [image data](#) is that of the entry and whose [state](#) is [completely available](#).
 5. [Prepare current request for presentation](#) given *img*.
 6. Set [current request's current pixel density](#) to *selected pixel density*.
 7. [Queue an element task](#) on the [DOM manipulation task source](#) given the [`img`](#) element and following steps:
 1. If *restart animation* is set, then [restart the animation](#).
 2. Set [current request's current URL](#) to *urlString*.
 3. [Fire an event](#) named [`load`](#) at the [`img`](#) element.
 8. Abort the [update the image data](#) algorithm.
 7. [Queue a microtask](#) to perform the rest of this algorithm, allowing the [task](#) that invoked this algorithm to continue.
 8. If another instance of this algorithm for this [`img`](#) element was started after this instance (even if it aborted and is no longer running), then return.

Only the last instance takes effect, to avoid multiple requests when, for example, the

`src`, `srcset`, and `crossorigin` attributes are all set in succession.

9. Let *selected source* and *selected pixel density* be the URL and pixel density that results from [selecting an image source](#), respectively.
10. If *selected source* is null, then:
 1. Set the [current request's state](#) to [broken](#), [abort the image request](#) for the [current request](#) and the [pending request](#), and set [pending request](#) to null.
 2. [Queue an element task](#) on the [DOM manipulation task source](#) given the [img](#) element and the following steps:
 1. Change the [current request's current URL](#) to the empty string.
 2. If the element has a [src](#) attribute or it [uses srcset or picture](#), [fire an event](#) named [error](#) at the [img](#) element.
 3. Return.
11. [Parse selected source](#), relative to the element's [node document](#), and let *urlString* be the [resulting URL string](#). If that is not successful, then:
 1. [Abort the image request](#) for the [current request](#) and the [pending request](#).
 2. Set the [current request's state](#) to [broken](#).
 3. Set [pending request](#) to null.
 4. [Queue an element task](#) on the [DOM manipulation task source](#) given the [img](#) element and the following steps:
 1. Change the [current request's current URL](#) to *selected source*.
 2. [Fire an event](#) named [error](#) at the [img](#) element.
 5. Return.
12. If the [pending request](#) is not null and *urlString* is the same as the [pending request's current URL](#), then return.
13. If *urlString* is the same as the [current request's current URL](#) and [current request's state](#) is [partially available](#), then [abort the image request](#) for the [pending request](#), [queue an element task](#) on the [DOM manipulation task source](#) given the [img](#) element to [restart the animation](#) if [restart animation](#) is set, and return.
14. If the [pending request](#) is not null, then [abort the image request](#) for the [pending request](#).

15. Set *image request* to a new [image request](#) whose [current URL](#) is *urlString*.
16. If [current request's state](#) is [unavailable](#) or [broken](#), then set the [current request](#) to *image request*. Otherwise, set the [pending request](#) to *image request*.
17. Let *request* be the result of [creating a potential-CORS request](#) given *urlString*, "image", and the current state of the element's [crossorigin](#) content attribute.
18. Set *request*'s [client](#) to the element's [node document](#)'s [relevant settings object](#).
19. If the element [uses srcset or picture](#), set *request*'s [initiator](#) to "imageset".
20. Set *request*'s [referrer policy](#) to the current state of the element's [referrerpolicy](#) attribute.
21. Let *delay load event* be true if the [img](#)'s [lazy loading attribute](#) is in the [Eager](#) state, or if [scripting is disabled](#) for the [img](#), and false otherwise.
22. If the [will lazy load element steps](#) given the [img](#) return true, then:
 1. Set the [img](#)'s [lazy load resumption steps](#) to the rest of this algorithm starting with the step labeled *fetch the image*.
 2. [Start intersection-observing a lazy loading element](#) for the [img](#) element.
 3. Return.
23. *Fetch the image*: [Fetch request](#). Let this instance of the [fetching](#) algorithm be associated with *image request*.

The resource obtained in this fashion, if any, is *image request*'s [image data](#). It can be either [CORS-same-origin](#) or [CORS-cross-origin](#); this affects the image's interaction with other APIs (e.g., when used on a [canvas](#)).

When *delay load event* is true, fetching the image must [delay the load event](#) of the element's [node document](#) until the [task](#) that is [queued](#) by the [networking task source](#) once the resource has been fetched ([defined below](#)) has been run.

This, unfortunately, can be used to perform a rudimentary port scan of the user's local network (especially in conjunction with scripting, though scripting isn't actually necessary to carry out such an attack). User agents may implement [cross-origin](#) access control policies that are stricter than those described above to mitigate this attack, but unfortunately such policies are typically not compatible with existing web content.

24. Continue the remaining steps [in parallel](#), but without missing any data from fetching.
25. As soon as possible, jump to the first applicable entry from the following list:

If the resource type is [multipart/x-mixed-replace](#)

The next [task](#) that is [queued](#) by the [networking task source](#) while the image is being fetched must run the following steps:

1. If *image request* is the [pending request](#) and at least one body part has been completely decoded, [abort the image request](#) for the [current request](#), [upgrade the pending request to the current request](#).
2. Otherwise, if *image request* is the [pending request](#) and the user agent is able to determine that *image request*'s image is corrupted in some fatal way such that the image dimensions cannot be obtained, [abort the image request](#) for the [current request](#), [upgrade the pending request to the current request](#), and set the [current request](#)'s [state](#) to [broken](#).
3. Otherwise, if *image request* is the [current request](#), its [state](#) is [unavailable](#), and the user agent is able to determine *image request*'s image's width and height, set the [current request](#)'s [state](#) to [partially available](#).
4. Otherwise, if *image request* is the [current request](#), its [state](#) is [unavailable](#), and the user agent is able to determine that *image request*'s image is corrupted in some fatal way such that the image dimensions cannot be obtained, set the [current request](#)'s [state](#) to [broken](#).

Each [task](#) that is [queued](#) by the [networking task source](#) while the image is being fetched must update the presentation of the image, but as each new body part comes in, if the user agent is able to determine the image's width and height, it must [prepare the img element's current request for presentation](#) given the [img](#) element and replace the previous image. Once one body part has been completely decoded, the user agent must set the [img](#) element's [current request](#)'s [state](#) to [completely available](#) and [queue an element task](#) on the [DOM manipulation task source](#) given the [img](#) element to [fire an event](#) named [load](#) at the [img](#) element.

If the resource type and data corresponds to a supported image format, [as described below](#)

The next [task](#) that is [queued](#) by the [networking task source](#) while the image is being fetched must run the following steps:

1. If the user agent is able to determine *image request*'s image's width and height, and *image request* is [pending request](#), set *image request*'s [state](#) to [partially available](#).
2. Otherwise, if the user agent is able to determine *image request*'s image's width and height, and *image request* is [current request](#), [prepare image request for presentation](#) given the [img](#) element and set *image request*'s [state](#) to [partially available](#).

3. Otherwise, if the user agent is able to determine that *image request*'s image is corrupted in some fatal way such that the image dimensions cannot be obtained, and *image request* is pending request, abort the image request for the current request and the pending request, upgrade the pending request to the current request, set current request's state to broken, and fire an event named error at the img element.
4. Otherwise, if the user agent is able to determine that *image request*'s image is corrupted in some fatal way such that the image dimensions cannot be obtained, and *image request* is current request, abort the image request for *image request* and fire an event named error at the img element.

That task, and each subsequent task, that is queued by the networking task source while the image is being fetched, if *image request* is the current request, must update the presentation of the image appropriately (e.g., if the image is a progressive JPEG, each packet can improve the resolution of the image).

Furthermore, the last task that is queued by the networking task source once the resource has been fetched must additionally run these steps:

1. If *image request* is the pending request, abort the image request for the current request, upgrade the pending request to the current request and prepare image request for presentation given the img element.
2. Set *image request* to the completely available state.
3. Add the image to the list of available images using the key key, with the ignore higher-layer caching flag set.
4. Fire an event named load at the img element.

Otherwise

The image data is not in a supported file format; the user agent must set *image request*'s state to broken, abort the image request for the current request and the pending request, upgrade the pending request to the current request if *image request* is the pending request, and then queue an element task on the DOM manipulation task source given the img element to fire an event named error at the img element.

While a user agent is running the above algorithm for an element *x*, there must be a strong reference from the element's node document to the element *x*, even if that element is not connected.

To abort the image request for an image request *image request* means to run the following steps:

1. Forget *image request*'s image data, if any.

2. Abort any instance of the [fetching](#) algorithm for *image request*, discarding any pending tasks generated by that algorithm.

To *upgrade the pending request to the current request* for an [img](#) element means to run the following steps:

1. Let the [img](#) element's [current request](#) be the [pending request](#).
2. Let the [img](#) element's [pending request](#) be null.

4.8.4.3.6 Preparing an image for presentation

To *prepare an image for presentation* for an [image request](#) *req* given image element *img*:

1. Let *exifTagMap* be the EXIF tags obtained from *req*'s [image data](#), as defined by the relevant codec. [\[EXIF\]](#)
2. Let *physicalWidth* and *physicalHeight* be the width and height obtained from *req*'s [image data](#), as defined by the relevant codec.
3. Let *dimX* be the value of *exifTagMap*'s tag **0xA002 (PixelXDimension)**.
4. Let *dimY* be the value of *exifTagMap*'s tag **0xA003 (PixelYDimension)**.
5. Let *resX* be the value of *exifTagMap*'s tag **0x011A (XResolution)**.
6. Let *resY* be the value of *exifTagMap*'s tag **0x011B (YResolution)**.
7. Let *resUnit* be the value of *exifTagMap*'s tag **0x0128 (ResolutionUnit)**.
8. If either *dimX* or *dimY* is not a positive integer, then return.
9. If either *resX* or *resY* is not a positive floating-point number, then return.
10. If *resUnit* is not equal to **2 (Inch)**, then return.
11. Let *widthFromDensity* be the value of *physicalWidth*, multiplied by 72 and divided by *resX*.
12. Let *heightFromDensity* be the value of *physicalHeight*, multiplied by 72 and divided by *resY*.
13. If *widthFromDensity* is not equal to *dimX* or *heightFromDensity* is not equal to *dimY*, then return.
14. If *req*'s [image data](#) is [CORS-cross-origin](#), then set *img*'s [intrinsic dimensions](#) to *dimX* and *dimY*, scale *img*'s pixel data accordingly, and return.

15. Set *req*'s [preferred density-corrected dimensions](#) to a struct with its width set to *dimX* and its height set to *dimY*.
16. Update *req*'s [`img`](#) element's presentation appropriately.

Resolution in EXIF is equivalent to [CSS points per inch](#), therefore 72 is the base for computing size from resolution.

It is not yet specified what would be the case if EXIF arrives after the image is already presented. See [issue #4929](#).

4.8.4.3.7 Selecting an image source

When asked to *select an image source* for a given [`img`](#) or [`link`](#) element *el*, user agents must do the following:

1. [Update the source set](#) for *el*.
2. If *el*'s [`source set`](#) is empty, return null as the URL and undefined as the pixel density.
3. Otherwise, take *el*'s [`source set`](#) and let it be *source set*.
4. If an entry *b* in *source set* has the same associated [pixel density descriptor](#) as an earlier entry *a* in *source set*, then remove entry *b*. Repeat this step until none of the entries in *source set* have the same associated [pixel density descriptor](#) as an earlier entry.
5. In a user agent-specific manner, choose one [`image source`](#) from *source set*. Let this be *selected source*.
6. Return *selected source* and its associated pixel density.

4.8.4.3.8 Updating the source set

When asked to *update the source set* for a given [`img`](#) or [`link`](#) element *el*, user agents must do the following:

1. Set *el*'s [`source set`](#) to an empty [`source set`](#).
2. Let *elements* be `« el »`.
3. If *el* is an [`img`](#) element whose parent node is a [`picture`](#) element, then [replace](#) the contents of *elements* with *el*'s parent node's child elements, retaining relative order.
4. [For each](#) *child* in *elements*:
 1. If *child* is *el*:

1. Let *source set* be an empty [source set](#).
2. If *child* has a [srcset](#) or [imagesrcset](#) attribute, [parse child's srcset attribute](#) and set *source set* to the returned [source set](#).
3. [Parse child's sizes attribute](#), and let *source set*'s [source size](#) be the returned value.
4. If *child* has a [src](#) or [href](#) attribute whose value is not the empty string and *source set* does not contain an [image source](#) with a [pixel density descriptor](#) value of 1, and no [image source](#) with a [width descriptor](#), append *child*'s [src](#) or [href](#) attribute value to *source set*.
5. [Normalize the source densities](#) of *source set*.
6. Let *el*'s [source set](#) be *source set*.
7. Return.

If *el* is a [link](#) element, then *elements* contains only *el*, so this step will be reached immediately and the rest of the algorithm will not run.

2. If *child* is not a [source](#) element, then [continue](#).
3. If *child* does not have a [srcset](#) attribute, [continue](#) to the next child.
4. [Parse child's srcset attribute](#) and let the returned [source set](#) be *source set*.
5. If *source set* has zero [image sources](#), [continue](#) to the next child.
6. If *child* has a [media](#) attribute, and its value does not [match the environment](#), [continue](#) to the next child.
7. [Parse child's sizes attribute](#), and let *source set*'s [source size](#) be the returned value.
8. If *child* has a [type](#) attribute, and its value is an unknown or unsupported [MIME type](#), [continue](#) to the next child.
9. If *child* has [width](#) or [height](#) attributes, set *el*'s [dimension attribute source](#) to *child*. Otherwise, set *el*'s [dimension attribute source](#) to *el*.
10. [Normalize the source densities](#) of *source set*.
11. Let *el*'s [source set](#) be *source set*.
12. Return.

Each [img](#) element independently considers its previous sibling [source](#) elements plus the [img](#)

element itself for selecting an [image source](#), ignoring any other (invalid) elements, including other [img](#) elements in the same [picture](#) element, or [source](#) elements that are following siblings of the relevant [img](#) element.

4.8.4.3.9 Parsing a srcset attribute

When asked to *parse a srcset attribute* from an element, parse the value of the element's [srcset attribute](#) as follows:

1. Let *input* be the value passed to this algorithm.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. Let *candidates* be an initially empty [source set](#).
4. *Splitting loop*: [Collect a sequence of code points](#) that are [ASCII whitespace](#) or U+002C COMMA characters from *input* given *position*. If any U+002C COMMA characters were collected, that is a [parse error](#).
5. If *position* is past the end of *input*, return *candidates*.
6. [Collect a sequence of code points](#) that are not [ASCII whitespace](#) from *input* given *position*, and let that be *url*.
7. Let *descriptors* be a new empty list.
8. If *url* ends with U+002C (,), then:
 1. Remove all trailing U+002C COMMA characters from *url*. If this removed more than one character, that is a [parse error](#).

Otherwise:

1. *Descriptor tokenizer*: [Skip ASCII whitespace](#) within *input* given *position*.
2. Let *current descriptor* be the empty string.
3. Let *state* be *in descriptor*.
4. Let *c* be the character at *position*. Do the following depending on the value of *state*. For the purpose of this step, "EOF" is a special character representing that *position* is past the end of *input*.

In descriptor

Do the following, depending on the value of *c*:

ASCII whitespace

If *current descriptor* is not empty, append *current descriptor* to *descriptors* and let *current descriptor* be the empty string. Set *state* to *after descriptor*.

U+002C COMMA (,)

Advance *position* to the next character in *input*. If *current descriptor* is not empty, append *current descriptor* to *descriptors*. Jump to the step labeled *descriptor parser*.

U+0028 LEFT PARENTHESIS ()

Append *c* to *current descriptor*. Set *state* to *in parens*.

EOF

If *current descriptor* is not empty, append *current descriptor* to *descriptors*. Jump to the step labeled *descriptor parser*.

Anything else

Append *c* to *current descriptor*.

In parens

Do the following, depending on the value of *c*:

U+0029 RIGHT PARENTHESIS ()

Append *c* to *current descriptor*. Set *state* to *in descriptor*.

EOF

Append *current descriptor* to *descriptors*. Jump to the step labeled *descriptor parser*.

Anything else

Append *c* to *current descriptor*.

After descriptor

Do the following, depending on the value of *c*:

[ASCII whitespace](#)

Stay in this state.

EOF

Jump to the step labeled *descriptor parser*.

Anything else

Set *state* to *in descriptor*. Set *position* to the previous character in *input*.

Advance *position* to the next character in *input*. Repeat this step.

In order to be compatible with future additions, this algorithm supports multiple descriptors and descriptors with parens.

9. *Descriptor parser*: Let *error* be *no*.

10. Let *width* be *absent*.

11. Let *density* be *absent*.

12. Let *future-compat-h* be *absent*.

13. For each descriptor in *descriptors*, run the appropriate set of steps from the following list:

If the descriptor consists of a [valid non-negative integer](#) followed by a U+0077 LATIN SMALL LETTER W character

1. If the user agent does not support the [sizes](#) attribute, let *error* be *yes*.

A conforming user agent will support the [sizes](#) attribute. However, user agents typically implement and ship features in an incremental manner in practice.

2. If *width* and *density* are not both *absent*, then let *error* be *yes*.

3. Apply the [rules for parsing non-negative integers](#) to the descriptor. If the result is zero, let *error* be *yes*. Otherwise, let *width* be the result.

If the descriptor consists of a [valid floating-point number](#) followed by a U+0078 LATIN SMALL LETTER X character

1. If *width*, *density* and *future-compat-h* are not all *absent*, then let *error* be *yes*.

2. Apply the [rules for parsing floating-point number values](#) to the descriptor. If the result is less than zero, let *error* be yes. Otherwise, let *density* be the result.

If *density* is zero, the [intrinsic dimensions](#) will be infinite. User agents are expected to have limits in how big images can be rendered, which is allowed by the [hardware limitations](#) clause.

If the descriptor consists of a [valid non-negative integer](#) followed by a U+0068 LATIN SMALL LETTER H character

This is a [parse error](#).

1. If *future-compat-h* and *density* are not both *absent*, then let *error* be yes.
2. Apply the [rules for parsing non-negative integers](#) to the descriptor. If the result is zero, let *error* be yes. Otherwise, let *future-compat-h* be the result.

Anything else

Let *error* be yes.

14. If *future-compat-h* is not *absent* and *width* is *absent*, let *error* be yes.
15. If *error* is still *no*, then append a new [image source](#) to *candidates* whose URL is *url*, associated with a width *width* if not *absent* and a pixel density *density* if not *absent*. Otherwise, there is a [parse error](#).
16. Return to the step labeled *splitting loop*.

4.8.4.3.10 Parsing a sizes attribute

When asked to *parse a sizes attribute* from an element, [parse a comma-separated list of component values](#) from the value of the element's [sizes attribute](#) (or the empty string, if the attribute is absent), and let *unparsed sizes list* be the result. [\[CSSSYNTAX\]](#)

For each *unparsed size* in *unparsed sizes list*:

1. Remove all consecutive [`<whitespace-token>`s](#) from the end of *unparsed size*. If *unparsed size* is now empty, that is a [parse error](#); [continue](#).
2. If the last [component value](#) in *unparsed size* is a valid non-negative [`<source-size-value>`](#), let *size* be its value and remove the [component value](#) from *unparsed size*. Any CSS function other than the [math functions](#) is invalid. Otherwise, there is a [parse error](#); [continue](#).
3. Remove all consecutive [`<whitespace-token>`s](#) from the end of *unparsed size*. If

unparsed size is now empty, return *size* and exit this algorithm. If this was not the last item in *unparsed sizes list*, that is a [parse error](#).

4. Parse the remaining [component values](#) in *unparsed size* as a [`<media-condition>`](#). If it does not parse correctly, or it does parse correctly but the [`<media-condition>`](#) evaluates to false, [continue](#). [MQ]
5. Return *size* and exit this algorithm.

If the above algorithm exhausts *unparsed sizes list* without returning a *size* value, then return **100vw**.

While a [valid source size list](#) only contains a bare [`<source-size-value>`](#) (without an accompanying [`<media-condition>`](#)) as the last entry in the [`<source-size-list>`](#), the parsing algorithm technically allows such at any point in the list, and will accept it immediately as the size if the preceding entries in the list weren't used. This is to enable future extensions, and protect against simple author errors such as a final trailing comma.

4.8.4.3.11 Normalizing the source densities

An [image source](#) can have a [pixel density descriptor](#), a [width descriptor](#), or no descriptor at all accompanying its URL. Normalizing a [source set](#) gives every [image source](#) a [pixel density descriptor](#).

When asked to *normalize the source densities* of a [source set](#) source set, the user agent must do the following:

1. Let *source size* be *source set's source size*.
2. For each [image source](#) in *source set*:
 1. If the [image source](#) has a [pixel density descriptor](#), [continue](#) to the next [image source](#).
 2. Otherwise, if the [image source](#) has a [width descriptor](#), replace the [width descriptor](#) with a [pixel density descriptor](#) with a [value](#) of the [width descriptor value](#) divided by the [source size](#) and a unit of *x*.

If the [source size](#) is zero, the density would be infinity, which results in the [intrinsic dimensions](#) being zero by zero.

3. Otherwise, give the [image source](#) a [pixel density descriptor](#) of **1x**.

4.8.4.3.12 Reacting to environment changes

The user agent may at any time run the following algorithm to update an [img](#) element's image

in order to react to changes in the environment. (User agents are *not required* to ever run this algorithm; for example, if the user is not looking at the page any more, the user agent might want to wait until the user has returned to the page before determining which image to use, in case the environment changes again in the meantime.)

User agents are encouraged to run this algorithm in particular when the user changes the [viewport](#)'s size (e.g. by resizing the window or changing the page zoom), and when an [img](#) element is [inserted into a document](#), so that the [density-corrected intrinsic width and height](#) match the new [viewport](#), and so that the correct image is chosen when [art direction](#) is involved.

1. [Await a stable state](#). The [synchronous section](#) consists of all the remaining steps of this algorithm until the algorithm says the [synchronous section](#) has ended. (Steps in [synchronous sections](#) are marked with ☒.)
 2. ☒ If the [img](#) element does not [use srcset or picture](#), its [node document](#) is not the [active document](#), has image data whose resource type is [multipart/x-mixed-replace](#), or the [pending request](#) is not null, then return.
 3. ☒ Let *selected source* and *selected pixel density* be the URL and pixel density that results from [selecting an image source](#), respectively.
 4. ☒ If *selected source* is null, then return.
 5. ☒ If *selected source* and *selected pixel density* are the same as the element's [last selected source](#) and [current pixel density](#), then return.
 6. ☒ [Parse](#) *selected source*, relative to the element's [node document](#), and let *urlString* be the [resulting URL string](#). If that is not successful, then return.
 7. ☒ Let *corsAttributeState* be the state of the element's [crossorigin](#) content attribute.
 8. ☒ Let *origin* be the [img](#) element's [node document](#)'s [origin](#).
 9. ☒ Let *client* be the [img](#) element's [node document](#)'s [relevant settings object](#).
 10. ☒ Let *key* be a tuple consisting of *urlString*, *corsAttributeState*, and, if *corsAttributeState* is not [No CORS](#), *origin*.
 11. ☒ Let *image request* be a new [image request](#) whose [current URL](#) is *urlString*
 12. ☒ Let the element's [pending request](#) be *image request*.
 13. End the [synchronous section](#), continuing the remaining steps [in parallel](#).
 14. If the [list of available images](#) contains an entry for *key*, then set *image request*'s [image data](#) to that of the entry. Continue to the next step.
- Otherwise:

1. Let *request* be the result of [creating a potential-CORS request](#) given *urlString*, "image", and *corsAttributeState*.
 2. Set *request*'s [client](#) to *client*, [initiator](#) to "imageset", and set *request*'s [synchronous flag](#).
 3. Set *request*'s [referrer policy](#) to the current state of the element's [referrerpolicy](#) attribute.
 4. Let *response* be the result of [fetching](#) *request*.
 5. If *response*'s [unsafe response](#) is a [network error](#) or if the image format is unsupported (as determined by applying the [image sniffing rules](#), again as mentioned earlier), or if the user agent is able to determine that *image request*'s image is corrupted in some fatal way such that the image dimensions cannot be obtained, or if the resource type is [multipart/x-mixed-replace](#), then let [pending request](#) be null and abort these steps.
 6. Otherwise, *response*'s [unsafe response](#) is *image request*'s [image data](#). It can be either [CORS-same-origin](#) or [CORS-cross-origin](#); this affects the image's interaction with other APIs (e.g., when used on a [canvas](#)).
15. [Queue an element task](#) on the [DOM manipulation task source](#) given the [img](#) element and the following steps:
1. If the [img](#) element has experienced [relevant mutations](#) since this algorithm started, then let [pending request](#) be null and abort these steps.
 2. Let the [img](#) element's [last selected source](#) be [selected source](#) and the [img](#) element's [current pixel density](#) be [selected pixel density](#).
 3. Set the *image request*'s [state](#) to [completely available](#).
 4. Add the image to the [list of available images](#) using the key *key*, with the [ignore higher-layer caching](#) flag set.
 5. [Upgrade the pending request to the current request](#).
 6. [Prepare image request for presentation](#) given the [img](#) element.
 7. [Fire an event](#) named [load](#) at the [img](#) element.

4.8.4.4 Requirements for providing text to act as an alternative for images

4.8.4.4.1 General guidelines

Except where otherwise specified, the [alt](#) attribute must be specified and its value must not be

empty; the value must be an appropriate replacement for the image. The specific requirements for the [alt](#) attribute depend on what the image is intended to represent, as described in the following sections.

The most general rule to consider when writing alternative text is the following: the intent is that replacing every image with the text of its [alt](#) attribute does not change the meaning of the page.

So, in general, alternative text can be written by considering what one would have written had one not been able to include the image.

A corollary to this is that the [alt](#) attribute's value should never contain text that could be considered the image's *caption*, *title*, or *legend*. It is supposed to contain replacement text that could be used by users *instead* of the image; it is not meant to supplement the image. The [title](#) attribute can be used for supplemental information.

Another corollary is that the [alt](#) attribute's value should not repeat information that is already provided in the prose next to the image.

One way to think of alternative text is to think about how you would read the page containing the image to someone over the phone, without mentioning that there is an image present. Whatever you say instead of the image is typically a good start for writing the alternative text.

4.8.4.4.2 A link or button containing nothing but the image

When an [a](#) element that creates a [hyperlink](#), or a [button](#) element, has no textual content but contains one or more images, the [alt](#) attributes must contain text that together convey the purpose of the link or button.

In this example, a user is asked to pick their preferred color from a list of three. Each color is given by an image, but for users who have configured their user agent not to display images, the color names are used instead:

```
<h1>Pick your color</h1>
<ul>
  <li><a href="green.html"></a></li>
  <li><a href="blue.html"></a></li>
  <li><a href="red.html"></a></li>
</ul>
```

In this example, each button has a set of images to indicate the kind of color output desired by the user. The first image is used in each case to give the alternative text.

```
<button name="rgb">
<button name="cmyk">
```

Since each image represents one part of the text, it could also be written like this:

```
<button name="rgb"></button>
<button name="cmyk"></button>
```

However, with other alternative text, this might not work, and putting all the alternative text into one image in each case might make more sense:

```
<button name="rgb"></button>
<button name="cmyk"></button>
```

4.8.4.4.3 A phrase or paragraph with an alternative graphical representation: charts, diagrams, graphs, maps, illustrations

Sometimes something can be more clearly stated in graphical form, for example as a flowchart, a diagram, a graph, or a simple map showing directions. In such cases, an image can be given using the `img` element, but the lesser textual version must still be given, so that users who are unable to view the image (e.g. because they have a very slow connection, or because they are using a text-only browser, or because they are listening to the page being read out by a hands-free automobile voice web browser, or simply because they are blind) are still able to understand the message being conveyed.

The text must be given in the `alt` attribute, and must convey the same message as the image specified in the `src` attribute.

It is important to realize that the alternative text is a *replacement* for the image, not a description of the image.

In the following example we have a [flowchart](#) in image form, with text in the `alt` attribute rephrasing the flowchart in prose form:

```
<p>In the common case, the data handled by the tokenization stage comes from the network, but it can also come from script.</p>
<p></p>
```

Here's another example, showing a good solution and a bad solution to the problem of including an image in a description.

First, here's the good solution. This sample shows how the alternative text should just be what you would have put in the prose if the image had never existed.

```
<!-- This is the correct way to do things. -->
<p>
  You are standing in an open field west of a house.
  
```

```
There is a small mailbox here.  
</p>
```

Second, here's the bad solution. In this incorrect way of doing things, the alternative text is simply a description of the image, instead of a textual replacement for the image. It's bad because when the image isn't shown, the text doesn't flow as well as in the first example.

```
<!-- This is the wrong way to do things. -->  
<p>  
    You are standing in an open field west of a house.  
      
    There is a small mailbox here.  
</p>
```

Text such as "Photo of white house with boarded door" would be equally bad alternative text (though it could be suitable for the [title](#) attribute or in the [figcaption](#) element of a [figure](#) with this image).

4.8.4.4.4 A short phrase or label with an alternative graphical representation: icons, logos

A document can contain information in iconic form. The icon is intended to help users of visual browsers to recognize features at a glance.

In some cases, the icon is supplemental to a text label conveying the same meaning. In those cases, the [alt](#) attribute must be present but must be empty.

Here the icons are next to text that conveys the same meaning, so they have an empty [alt](#) attribute:

```
<nav>  
    <p><a href="/help/"> Help</a></p>  
    <p><a href="/configure/">  
        Configuration Tools</a></p>  
</nav>
```

In other cases, the icon has no text next to it describing what it means; the icon is supposed to be self-explanatory. In those cases, an equivalent textual label must be given in the [alt](#) attribute.

Here, posts on a news site are labeled with an icon indicating their topic.

```
<body>  
    <article>  
        <header>  
            <h1>Ratatouille wins <i>Best Movie of the Year</i> award</h1>  
            <p></p>  
        </header>
```

```

<p>Pixar has won yet another <i>Best Movie of the Year</i> award,  

making this its 8th win in the last 12 years.</p>
</article>
<article>
  <header>
    <h1>Latest TWiT episode is online</h1>
    <p></p>
  </header>
  <p>The latest TWiT episode has been posted, in which we hear  

several tech news stories as well as learning much more about the  

iPhone. This week, the panelists compare how reflective their  

iPhones' Apple logos are.</p>
</article>
</body>
```

Many pages include logos, insignia, flags, or emblems, which stand for a particular entity such as a company, organization, project, band, software package, country, or some such.

If the logo is being used to represent the entity, e.g. as a page heading, the [alt](#) attribute must contain the name of the entity being represented by the logo. The [alt](#) attribute must *not* contain text like the word "logo", as it is not the fact that it is a logo that is being conveyed, it's the entity itself.

If the logo is being used next to the name of the entity that it represents, then the logo is supplemental, and its [alt](#) attribute must instead be empty.

If the logo is merely used as decorative material (as branding, or, for example, as a side image in an article that mentions the entity to which the logo belongs), then the entry below on purely decorative images applies. If the logo is actually being discussed, then it is being used as a phrase or paragraph (the description of the logo) with an alternative graphical representation (the logo itself), and the first entry above applies.

In the following snippets, all four of the above cases are present. First, we see a logo used to represent a company:

```
<h1></h1>
```

Next, we see a paragraph which uses a logo right next to the company name, and so doesn't have any alternative text:

```

<article>
  <h2>News</h2>
  <p>We have recently been looking at buying the  ABΓ company, a small Greek company
  specializing in our type of product.</p>
```

In this third snippet, we have a logo being used in an aside, as part of the larger article

discussing the acquisition:

```
<aside><p></p></aside>
<p>The ABΓ company has had a good quarter, and our
pie chart studies of their accounts suggest a much bigger blue slice
than its green and orange slices, which is always a good sign.</p>
</article>
```

Finally, we have an opinion piece talking about a logo, and the logo is therefore described in detail in the alternative text.

```
<p>Consider for a moment their logo:</p>
```

```
<p></p>
```

```
<p>How unoriginal can you get? I mean, oooooh, a question mark, how
<em>revolutionary</em>, how utterly <em>ground-breaking</em>, I'm
sure everyone will rush to adopt those specifications now! They could
at least have tried for some sort of, I don't know, sequence of
rounded squares with varying shades of green and bold white outlines,
at least that would look good on the cover of a blue book.</p>
```

This example shows how the alternative text should be written such that if the image isn't available, and the text is used instead, the text flows seamlessly into the surrounding text, as if the image had never been there in the first place.

4.8.4.4.5 Text that has been rendered to a graphic for typographical effect

Sometimes, an image just consists of text, and the purpose of the image is not to highlight the actual typographic effects used to render the text, but just to convey the text itself.

In such cases, the alt attribute must be present but must consist of the same text as written in the image itself.

Consider a graphic containing the text "Earth Day", but with the letters all decorated with flowers and plants. If the text is merely being used as a heading, to spice up the page for graphical users, then the correct alternative text is just the same text "Earth Day", and no mention need be made of the decorations:

```
<h1></h1>
```

An illuminated manuscript might use graphics for some of its images. The alternative text in such a situation is just the character that the image represents.

```
<p>nce upon a time and a long long time ago
night, when it was dark, over the hills, through the woods, across a great occ
```

away, in a small house, on a hill, under a full moon...

When an image is used to represent a character that cannot otherwise be represented in Unicode, for example gaiji, itaiji, or new characters such as novel currency symbols, the alternative text should be a more conventional way of writing the same thing, e.g. using the phonetic hiragana or katakana to give the character's pronunciation.

In this example from 1997, a new-fangled currency symbol that looks like a curly E with two bars in the middle instead of one is represented using an image. The alternative text gives the character's pronunciation.

```
<p>Only 5.99!
```

An image should not be used if characters would serve an identical purpose. Only when the text cannot be directly represented using text, e.g., because of decorations or because there is no appropriate character (as in the case of gaiji), would an image be appropriate.

If an author is tempted to use an image because their default system font does not support a given character, then web fonts are a better solution than images.

4.8.4.4.6 A graphical representation of some of the surrounding text

In many cases, the image is actually just supplementary, and its presence merely reinforces the surrounding text. In these cases, the [alt](#) attribute must be present but its value must be the empty string.

In general, an image falls into this category if removing the image doesn't make the page any less useful, but including the image makes it a lot easier for users of visual browsers to understand the concept.

A flowchart that repeats the previous paragraph in graphical form:

```
<p>The Network passes data to the Input Stream Preprocessor, which  
passes it to the Tokenizer, which passes it to the Tree Construction  
stage. From there, data goes to both the DOM and to Script Execution.  
Script Execution is linked to the DOM, and, using document.write(),  
passes data to the Tokenizer.</p>  
<p></p>
```

In these cases, it would be wrong to include alternative text that consists of just a caption. If a caption is to be included, then either the [title](#) attribute can be used, or the [figure](#) and [figcaption](#) elements can be used. In the latter case, the image would in fact be a phrase or paragraph with an alternative graphical representation, and would thus require alternative text.

```
<!-- Using the title="" attribute -->  
<p>The Network passes data to the Input Stream Preprocessor, which
```

passes it to the Tokenizer, which passes it to the Tree Construction stage. From there, data goes to both the DOM and to Script Execution. Script Execution is linked to the DOM, and, using `document.write()`, passes data to the Tokenizer.</p>

```
<p></p>
```

<!-- Using <figure> and <figcaption> -->

<p>The Network passes data to the Input Stream Preprocessor, which passes it to the Tokenizer, which passes it to the Tree Construction stage. From there, data goes to both the DOM and to Script Execution. Script Execution is linked to the DOM, and, using `document.write()`, passes data to the Tokenizer.</p>

```
<figure>
```

```
  
```

```
  <figcaption>Flowchart representation of the parsing model.</figcaption>
```

```
</figure>
```

<!-- This is WRONG. Do not do this. Instead, do what the above examples do. -->

<p>The Network passes data to the Input Stream Preprocessor, which passes it to the Tokenizer, which passes it to the Tree Construction stage. From there, data goes to both the DOM and to Script Execution. Script Execution is linked to the DOM, and, using `document.write()`, passes data to the Tokenizer.</p>

```
<p></p>
```

```
<!-- Never put the image's caption in the alt="" attribute! -->
```

A graph that repeats the previous paragraph in graphical form:

<p>According to a study covering several billion pages, about 62% of documents on the web in 2007 triggered the Quirks rendering mode of web browsers, about 30% triggered the Almost Standards mode, and about 9% triggered the Standards mode.</p>

```
<p></p>
```

4.8.4.4.7 Ancillary images

Sometimes, an image is not critical to the content, but is nonetheless neither purely decorative nor entirely redundant with the text. In these cases, the `alt` attribute must be present, and its value should either be the empty string, or a textual representation of the information that the

image conveys. If the image has a caption giving the image's title, then the `alt` attribute's value must not be empty (as that would be quite confusing for non-visual readers).

Consider a news article about a political figure, in which the individual's face was shown in an image. The image is not purely decorative, as it is relevant to the story. The image is not entirely redundant with the story either, as it shows what the politician looks like. Whether any alternative text need be provided is an authoring decision, decided by whether the image influences the interpretation of the prose.

In this first variant, the image is shown without context, and no alternative text is provided:

```
<p> Ahead of today's referendum,  
the President wrote an open letter to all registered voters. In it, she admit  
divided.</p>
```

If the picture is just a face, there might be no value in describing it. It's of no interest to the reader whether the individual has red hair or blond hair, whether the individual has white skin or black skin, whether the individual has one eye or two eyes.

However, if the picture is more dynamic, for instance showing the politician as angry, or particularly happy, or devastated, some alternative text would be useful in setting the tone of the article, a tone that might otherwise be missed:

```
<p>  
Ahead of today's referendum, the President wrote an open letter to all  
registered voters. In it, she admitted that the country was divided.  

```

```
<p>  
Ahead of today's referendum, the President wrote an open letter to all  
registered voters. In it, she admitted that the country was divided.  

```

Whether the individual was "sad" or "happy" makes a difference to how the rest of the paragraph is to be interpreted: is she likely saying that she is unhappy with the country being divided, or is she saying that the prospect of a divided country is good for her political career? The interpretation varies based on the image.

If the image has a caption, then including alternative text avoids leaving the non-visual user confused as to what the caption refers to.

```
<p>Ahead of today's referendum, the President wrote an open letter to  
all registered voters. In it, she admitted that the country was divided.</p>  
<figure>  
The Lady of Shalott</h1>
<p></p>
<p>On either side the river lie<br>
Long fields of barley and of rye,<br>
That clothe the wold and meet the sky;<br>
And through the field the road run by<br>
To many-tower'd Camelot;<br>
And up and down the people go,<br>
Gazing where the lilies blow<br>
Round an island there below,<br>
The island of Shalott.</p>
```

4.8.4.4.9 A group of images that form a single larger picture with no links

When a picture has been sliced into smaller image files that are then displayed together to form the complete picture again, one of the images must have its `alt` attribute set as per the relevant rules that would be appropriate for the picture as a whole, and then all the remaining images must have their `alt` attribute set to the empty string.

In the following example, a picture representing a company logo for XYZ Corp has been split into two pieces, the first containing the letters "XYZ" and the second with the word "Corp". The alternative text ("XYZ Corp") is all in the first image.

```
<h1></h1>
```

In the following example, a rating is shown as three filled stars and two empty stars. While the alternative text could have been "★★★☆☆", the author has instead decided to more helpfully give the rating in the form "3 out of 5". That is the alternative text of the first image, and the rest have blank alternative text.

```
<p>Rating: <meter max=5 value=3>
</meter></p>
```

4.8.4.4.10 A group of images that form a single larger picture with links

Generally, [image maps](#) should be used instead of slicing an image for links.

However, if an image is indeed sliced and any of the components of the sliced picture are the sole contents of links, then one image per link must have alternative text in its [alt](#) attribute representing the purpose of the link.

In the following example, a picture representing the flying spaghetti monster emblem, with each of the left noodly appendages and the right noodly appendages in different images, so that the user can pick the left side or the right side in an adventure.

```
<h1>The Church</h1>
<p>You come across a flying spaghetti monster. Which side of His
Noodliness do you wish to reach out for?</p>
<p><a href="?go=left" ></a>
   
   <a href="?go=right"></a></p>
```

4.8.4.4.11 A key part of the content

In some cases, the image is a critical part of the content. This could be the case, for instance, on a page that is part of a photo gallery. The image is the whole *point* of the page containing it.

How to provide alternative text for an image that is a key part of the content depends on the image's provenance.

The general case

When it is possible for detailed alternative text to be provided, for example if the image is part of a series of screenshots in a magazine review, or part of a comic strip, or is a photograph in a blog entry about that photograph, text that can serve as a substitute for the image must be given as the contents of the [alt](#) attribute.

A screenshot in a gallery of screenshots for a new OS, with some alternative text:

```
<figure>
  
<figcaption>Screenshot of a KDE desktop.</figcaption>
</figure>
```

A graph in a financial report:

```

```

Note that "sales graph" would be inadequate alternative text for a sales graph. Text that would be a good *caption* is not generally suitable as replacement text.

Images that defy a complete description

In certain cases, the nature of the image might be such that providing thorough alternative text is impractical. For example, the image could be indistinct, or could be a complex fractal, or could be a detailed topographical map.

In these cases, the [alt](#) attribute must contain some suitable alternative text, but it may be somewhat brief.

Sometimes there simply is no text that can do justice to an image. For example, there is little that can be said to usefully describe a Rorschach inkblot test. However, a description, even if brief, is still better than nothing:

```
<figure>
  
  <figcaption>A black outline of the first of the ten cards
in the Rorschach inkblot test.</figcaption>
</figure>
```

Note that the following would be a very bad use of alternative text:

```
<!-- This example is wrong. Do not copy it. -->
<figure>
  
  <figcaption>A black outline of the first of the ten cards
```

```
in the Rorschach inkblot test.</figcaption>
</figure>
```

Including the caption in the alternative text like this isn't useful because it effectively duplicates the caption for users who don't have images, taunting them twice yet not helping them any more than if they had only read or heard the caption once.

Another example of an image that defies full description is a fractal, which, by definition, is infinite in detail.

The following example shows one possible way of providing alternative text for the full view of an image of the Mandelbrot set.

```

```

Similarly, a photograph of a person's face, for example in a biography, can be considered quite relevant and key to the content, but it can be hard to fully substitute text for:

```
<section class="bio">
  <h1>A Biography of Isaac Asimov</h1>
  <p>Born <b>Isaak Yudovich Ozimov</b> in 1920, Isaac was a prolific author
  <p></p>
  <p>Asimov was born in Russia, and moved to the US when he was three years
  <p>...</p>
</section>
```

In such cases it is unnecessary (and indeed discouraged) to include a reference to the presence of the image itself in the alternative text, since such text would be redundant with the browser itself reporting the presence of the image. For example, if the alternative text was "A photo of Isaac Asimov", then a conforming user agent might read that out as "(Image) A photo of Isaac Asimov" rather than the more useful "(Image) Isaac Asimov had dark hair, a tall forehead, and wore glasses...".

Images whose contents are not known

In some unfortunate cases, there might be no alternative text available at all, either because the image is obtained in some automated fashion without any associated alternative text (e.g. a Webcam), or because the page is being generated by a script using user-provided images where the user did not provide suitable or usable alternative text (e.g. photograph sharing sites), or because the author does not themselves know what the images represent (e.g. a blind photographer sharing an image on their blog).

In such cases, the [alt](#) attribute may be omitted, but one of the following conditions must

be met as well:

- The `img` element is in a `figure` element that contains a `figcaption` element that contains content other than `inter-element whitespace`, and, ignoring the `figcaption` element and its descendants, the `figure` element has no `flow content` descendants other than `inter-element whitespace` and the `img` element.
- The `title` attribute is present and has a non-empty value.

Relying on the `title` attribute is currently discouraged as many user agents do not expose the attribute in an accessible manner as required by this specification (e.g. requiring a pointing device such as a mouse to cause a tooltip to appear, which excludes keyboard-only users and touch-only users, such as anyone with a modern phone or tablet).

Such cases are to be kept to an absolute minimum. If there is even the slightest possibility of the author having the ability to provide real alternative text, then it would not be acceptable to omit the `alt` attribute.

A photo on a photo-sharing site, if the site received the image with no metadata other than the caption, could be marked up as follows:

```
<figure>
  
  <figcaption>Bubbles traveled everywhere with us.</figcaption>
</figure>
```

It would be better, however, if a detailed description of the important parts of the image obtained from the user and included on the page.

A blind user's blog in which a photo taken by the user is shown. Initially, the user might not have any idea what the photo they took shows:

```
<article>
  <h1>I took a photo</h1>
  <p>I went out today and took a photo!</p>
  <figure>
    
    <figcaption>A photograph taken blindly from my front porch.</figcaption>
  </figure>
</article>
```

Eventually though, the user might obtain a description of the image from their friends and could then include alternative text:

```
<article>
  <h1>I took a photo</h1>
```

```

<p>I went out today and took a photo!</p>
<figure>
  
  <figcaption>A photograph taken blindly from my front porch.</figcaption>
</figure>
</article>

```

Sometimes the entire point of the image is that a textual description is not available, and the user is to provide the description. For instance, the point of a CAPTCHA image is to see if the user can literally read the graphic. Here is one way to mark up a CAPTCHA (note the [title](#) attribute):

```

<p><label>What does this image say?

<input type=text name=captcha></label>
(If you cannot see the image, you can use an <a
href="?audio">audio</a> test instead.)</p>

```

Another example would be software that displays images and asks for alternative text precisely for the purpose of then writing a page with correct alternative text. Such a page could have a table of images, like this:

```

<table>
  <thead>
    <tr> <th> Image <th> Description
  <tbody>
    <tr>
      <td> 
      <td> <input name="alt2421">
    <tr>
      <td> 
      <td> <input name="alt2422">
  </tbody>
</table>

```

Notice that even in this example, as much useful information as possible is still included in the [title](#) attribute.

Since some users cannot use images at all (e.g. because they have a very slow connection, or because they are using a text-only browser, or because they are listening to the page being read out by a hands-free automobile voice web browser, or simply because they are blind), the [alt](#) attribute is only allowed to be omitted rather than being provided with replacement text when no alternative text is available and none can be made available, as

in the above examples. Lack of effort from the part of the author is not an acceptable reason for omitting the [alt](#) attribute.

4.8.4.4.12 An image not intended for the user

Generally authors should avoid using [img](#) elements for purposes other than showing images.

If an [img](#) element is being used for purposes other than showing an image, e.g. as part of a service to count page views, then the [alt](#) attribute must be the empty string.

In such cases, the [width](#) and [height](#) attributes should both be set to zero.

4.8.4.4.13 An image in an email or private document intended for a specific person who is known to be able to view images

This section does not apply to documents that are publicly accessible, or whose target audience is not necessarily personally known to the author, such as documents on a web site, emails sent to public mailing lists, or software documentation.

When an image is included in a private communication (such as an HTML email) aimed at a specific person who is known to be able to view images, the [alt](#) attribute may be omitted. However, even in such cases authors are strongly urged to include alternative text (as appropriate according to the kind of image involved, as described in the above entries), so that the email is still usable should the user use a mail client that does not support images, or should the document be forwarded on to other users whose abilities might not include easily seeing images.

4.8.4.4.14 Guidance for markup generators

Markup generators (such as WYSIWYG authoring tools) should, wherever possible, obtain alternative text from their users. However, it is recognized that in many cases, this will not be possible.

For images that are the sole contents of links, markup generators should examine the link target to determine the title of the target, or the URL of the target, and use information obtained in this manner as the alternative text.

For images that have captions, markup generators should use the [figure](#) and [figcaption](#) elements, or the [title](#) attribute, to provide the image's caption.

As a last resort, implementers should either set the [alt](#) attribute to the empty string, under the assumption that the image is a purely decorative image that doesn't add any information but is still specific to the surrounding content, or omit the [alt](#) attribute altogether, under the assumption that the image is a key part of the content.

Markup generators may specify a *generator-unable-to-provide-required-alt*

attribute on `img` elements for which they have been unable to obtain alternative text and for which they have therefore omitted the `alt` attribute. The value of this attribute must be the empty string. Documents containing such attributes are not conforming, but conformance checkers will [silently ignore](#) this error.

This is intended to avoid markup generators from being pressured into replacing the error of omitting the `alt` attribute with the even more egregious error of providing phony alternative text, because state-of-the-art automated conformance checkers cannot distinguish phony alternative text from correct alternative text.

Markup generators should generally avoid using the image's own filename as the alternative text. Similarly, markup generators should avoid generating alternative text from any content that will be equally available to presentation user agents (e.g., web browsers).

This is because once a page is generated, it will typically not be updated, whereas the browsers that later read the page can be updated by the user, therefore the browser is likely to have more up-to-date and finely-tuned heuristics than the markup generator did when generating the page.

4.8.4.4.15 Guidance for conformance checkers

A conformance checker must report the lack of an `alt` attribute as an error unless one of the conditions listed below applies:

- The `img` element is in a `figure` element that satisfies [the conditions described above](#).
- The `img` element has a `title` attribute with a value that is not the empty string (also as [described above](#)).
- The conformance checker has been configured to assume that the document is an email or document intended for a specific person who is known to be able to view images.
- The `img` element has a (non-conforming) [`generator-unable-to-provide-required-alt`](#) attribute whose value is the empty string. A conformance checker that is not reporting the lack of an `alt` attribute as an error must also not report the presence of the empty [`generator-unable-to-provide-required-alt`](#) attribute as an error. (This case does not represent a case where the document is conforming, only that the generator could not determine appropriate alternative text — validators are not required to show an error in this case, because such an error might encourage markup generators to include bogus alternative text purely in an attempt to silence validators. Naturally, conformance checkers *may* report the lack of an `alt` attribute as an error even in the presence of the [`generator-unable-to-provide-required-alt`](#) attribute; for example, there could be a user option to report *all* conformance errors even those that might be the more or less inevitable result of using a markup generator.)

4.8.5 The ***iframe*** element

✓MDN

Element/iframe

Support in all current engines.

Firefox Yes Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

HTMLIFrameElement

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Embedded content.](#)

[Interactive content.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [embedded content](#) is expected.

Content model:

[Nothing.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[src](#) — Address of the resource

[srcdoc](#) — A document to render in the [iframe](#)

[name](#) — Name of [nested browsing context](#)

[sandbox](#) — Security rules for nested content

[allow](#) — [Permissions policy](#) to be applied to the [iframe](#)'s contents

[allowfullscreen](#) — Whether to allow the [iframe](#)'s contents to use [requestFullscreen\(\)](#)

[width](#) — Horizontal dimension

[height](#) — Vertical dimension

[referrerpolicy](#) — [Referrer policy](#) for [fetches](#) initiated by the element

[loading](#) — Used when determining loading deferral

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLIFrameElement : HTMLElement {
  HTMLConstructor constructor();

  CEReactions attribute USVString src;
  CEReactions attribute DOMString srcdoc;
  CEReactions attribute DOMString name;
  [SameObject, PutForwards=value] readonly attribute DOMTokenList sandbox;
  CEReactions attribute DOMString allow;
  CEReactions attribute boolean allowFullscreen;
  CEReactions attribute DOMString width;
  CEReactions attribute DOMString height;
  CEReactions attribute DOMString referrerPolicy;
  CEReactions attribute DOMString loading;
  readonly attribute Document? contentDocument;
  readonly attribute WindowProxy? contentWindow;
  Document? getSVGDocument();
}

// also has obsolete members
};
```

The [iframe](#) element represents its [nested browsing context](#).

The `src` attribute gives the [URL](#) of a page that the element's [nested browsing context](#) is to contain. The attribute, if present, must be a [valid non-empty URL potentially surrounded by spaces](#). If the `itemprop` attribute is specified on an [iframe](#) element, then the `src` attribute must also be specified.



[Element/iframe#attr-srcdoc](#)

Support in all current engines.

Firefox 25+ Safari 6+ Chrome 20+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 25+ Safari iOS? Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android?

The `srcdoc` attribute gives the content of the page that the element's [nested browsing context](#) is to contain. The value of the attribute is the source of *an iframe srcdoc document*.

The `srcdoc` attribute, if present, must have a value using [the HTML syntax](#) that consists of the following syntactic components, in the given order:

1. Any number of [comments](#) and [ASCII whitespace](#).
2. Optionally, a [DOCTYPE](#).
3. Any number of [comments](#) and [ASCII whitespace](#).
4. The [document element](#), in the form of an [html element](#).
5. Any number of [comments](#) and [ASCII whitespace](#).

The above requirements apply in [XML documents](#) as well.

Here a blog uses the `srcdoc` attribute in conjunction with the `sandbox` attribute described below to provide users of user agents that support this feature with an extra layer of protection from script injection in the blog post comments:

```
<article>
  <h1>I got my own magazine!</h1>
  <p>After much effort, I've finally found a publisher, and so now I
  have my own magazine! Isn't that awesome?! The first issue will come
  out in September, and we have articles about getting food, and about
  getting in boxes, it's going to be great!</p>
  <footer>
    <p>Written by <a href="/users/cap">cap</a>, 1 hour ago.</p>
  </footer>
</article>
```

```
<footer> Thirteen minutes ago, <a href="/users/ch">ch</a> wrote: </footer>
<iframe sandbox srcdoc=<p>did you get a cover picture yet?"></iframe>
</article>
<article>
  <footer> Nine minutes ago, <a href="/users/cap">cap</a> wrote: </footer>
  <iframe sandbox srcdoc=<p>Yeah, you can see it <a href="&quot;/gallery?mode=1&quot;">here</a>.</p></iframe>
</article>
<article>
  <footer> Five minutes ago, <a href="/users/ch">ch</a> wrote: </footer>
  <iframe sandbox srcdoc=<p>hey that's earl's table.
<p>you should get earl&amp;me on the next cover."></iframe>
</article>
```

Notice the way that quotes have to be escaped (otherwise the `srcdoc` attribute would end prematurely), and the way raw ampersands (e.g. in URLs or in prose) mentioned in the sandboxed content have to be *doubly* escaped — once so that the ampersand is preserved when originally parsing the `srcdoc` attribute, and once more to prevent the ampersand from being misinterpreted when parsing the sandboxed content.

Furthermore, notice that since the `DOCTYPE` is optional in [iframe srcdoc documents](#), and the `html`, `head`, and `body` elements have [optional start and end tags](#), and the `title` element is also optional in [iframe srcdoc documents](#), the markup in a `srcdoc` attribute can be relatively succinct despite representing an entire document, since only the contents of the `body` element need appear literally in the syntax. The other elements are still present, but only by implication.

In [the HTML syntax](#), authors need only remember to use U+0022 QUOTATION MARK characters ("") to wrap the attribute contents and then to escape all U+0026 AMPERSAND (&) and U+0022 QUOTATION MARK ("") characters, and to specify the `sandbox` attribute, to ensure safe embedding of content. (And remember to escape ampersands before quotation marks, to ensure quotation marks become " and not &quot;.)

In XML the U+003C LESS-THAN SIGN character (<) needs to be escaped as well. In order to prevent [attribute-value normalization](#), some of XML's whitespace characters — specifically U+0009 CHARACTER TABULATION (tab), U+000A LINE FEED (LF), and U+000D CARRIAGE RETURN (CR) — also need to be escaped. [\[XML\]](#)

If the `src` attribute and the `srcdoc` attribute are both specified together, the `srcdoc` attribute takes priority. This allows authors to provide a fallback [URL](#) for legacy user agents that do not support the `srcdoc` attribute.

When an `iframe` element *element* is [inserted into a document](#) whose [browsing context](#) is non-null, the user agent must run these steps:

1. [Create a new nested browsing context](#) for *element*.

2. If *element* has a `sandbox` attribute, then parse the sandboxing directive given the attribute's value and *element*'s `iframe` sandboxing flag set.
3. Process the `iframe` attributes for *element*, with `initialInsertion` set to true.

When an `iframe` element is removed from a document, the user agent must discard the element's nested browsing context, if it is not null, and then set the element's nested browsing context to null.

This happens without any `unload` events firing (the element's nested browsing context and its Document are discarded, not unloaded).

Whenever an `iframe` element with a non-null nested browsing context has its `srcdoc` attribute set, changed, or removed, the user agent must process the `iframe` attributes.

Similarly, whenever an `iframe` element with a non-null nested browsing context but with no `srcdoc` attribute specified has its `src` attribute set, changed, or removed, the user agent must process the `iframe` attributes.

To process the `iframe` attributes for an element *element*, with an optional boolean `initialInsertion` (default false):

1. If *element*'s `srcdoc` attribute is specified, then:
 1. Set *element*'s current navigation was lazy loaded boolean to false.
 2. If the will lazy load element steps given *element* return true, then:
 1. Set *element*'s lazy load resumption steps to the rest of this algorithm starting with the step labeled *navigate to the srcdoc resource*.
 2. Set *element*'s current navigation was lazy loaded boolean to true.
 3. Start intersection-observing a lazy loading element for *element*.
 4. Return.
 3. Navigate to the srcdoc resource: navigate an iframe or frame given *element* and a new response whose URL list is « about:srcdoc », header list is « (Content-Type, 'text/html') », and body is the value of *element*'s `srcdoc` attribute.

The resulting Document must be considered an iframe srcdoc document.

2. Otherwise, run the shared attribute processing steps for `iframe` and `frame` elements given *element* and `initialInsertion`.

The shared attribute processing steps for `iframe` and `frame` elements, given an element `element` and a boolean `initialInsertion`, are:

1. Let `url` be the [URL record `about:blank`](#).
 2. If `element` has a `src` attribute specified, and its value is not the empty string, then [parse](#) the value of that attribute relative to `element`'s [node document](#). If this is successful, then set `url` to the [resulting URL record](#).
 3. If there exists an [ancestor browsing context](#) of `element`'s [nested browsing context](#) whose [active document](#)'s [URL](#), ignoring [fragments](#), is equal to `url`, then return.
 4. If `url` [matches `about:blank`](#) and `initialInsertion` is true, then:
 1. Perform the [URL and history update steps](#) given `element`'s [nested browsing context](#)'s [active document](#) and `url`.
 - This is necessary in case `url` is something like `about:blank?foo`. If `url` is just plain `about:blank`, this will do nothing.
 2. Run the [iframe load event steps](#) given `element`.
 3. Return.
5. Let `resource` be a new [request](#) whose [URL](#) is `url` and whose [referrer policy](#) is the current state of `element`'s [referrerpolicy](#) content attribute.
 6. If `element` is an [iframe](#) element, then set `element`'s [current navigation was lazy loaded](#) boolean to false.
 7. If `element` is an [iframe](#) element, and the [will lazy load element steps](#) given `element` return true, then:
 1. Set `element`'s [lazy load resumption steps](#) to the rest of this algorithm starting with the step labeled `navigate to the resource`.
 2. Set `element`'s [current navigation was lazy loaded](#) boolean to true.
 3. [Start intersection-observing a lazy loading element](#) for `element`.
 4. Return.
8. [Navigate to the resource: navigate an iframe or frame](#) given `element` and `resource`.

To [navigate an iframe or frame](#) given an element `element` and a resource `resource`:

1. Let `historyHandling` be "[default](#)".

2. If *element*'s [nested browsing context](#) is [still on its initial about:blank Document](#), then set *historyHandling* to "[replace](#)".
3. If *element*'s [nested browsing context](#)'s [active document](#) is not [completely loaded](#), then set *historyHandling* to "[replace](#)".
4. [Navigate](#) *element*'s [nested browsing context](#) to resource, with [historyHandling](#) set to *historyHandling* and the [source browsing context](#) set to *element*'s [node document](#)'s [browsing context](#).

A [load](#) event is also fired at the [iframe](#) element when it is created if no other data is loaded in it.

Each [Document](#) has an *iframe load in progress* flag and a *mute iframe load* flag. When a [Document](#) is created, these flags must be unset for that [Document](#).

To run the *iframe load event steps*, given an [iframe](#) element *element*:

1. Assert: *element*'s [nested browsing context](#) is not null.
2. Let *childDocument* be the [active document](#) of *element*'s [nested browsing context](#).
3. If *childDocument* has its [mute iframe load](#) flag set, then return.
4. Set *childDocument*'s [iframe load in progress](#) flag.
5. [Fire an event](#) named [load](#) at *element*.
6. Unset *childDocument*'s [iframe load in progress](#) flag.

This, in conjunction with scripting, can be used to probe the URL space of the local network's HTTP servers. User agents may implement [cross-origin](#) access control policies that are stricter than those described above to mitigate this attack, but unfortunately such policies are typically not compatible with existing web content.

If an element type *potentially delays the load event*, then for each element *element* of that type, the user agent must [delay the load event](#) of *element*'s [node document](#) if *element*'s [nested browsing context](#) is non-null and any of the following are true:

- *element*'s [nested browsing context](#)'s [active document](#) is not [ready for post-load tasks](#).
- Anything is [delaying the load event](#) of *element*'s [nested browsing context](#)'s [active document](#).
- *element*'s [nested browsing context](#) is in the [delaying load events mode](#).

If, during the handling of the [load](#) event, *element*'s [nested browsing context](#) is again [navigated](#), that will further [delay the load event](#).

Each `iframe` element has an associated *current navigation was lazy loaded* boolean, initially false. It is set and unset in the [process the `iframe` attributes](#) algorithm.

An `iframe` element whose [current navigation was lazy loaded](#) boolean is false [potentially delays the load event](#).

If, when the element is created, the `srcdoc` attribute is not set, and the `src` attribute is either also not set or set but its value cannot be [parsed](#), the browsing context will remain at the [initial about:blank Document](#).

If the user [navigates](#) away from this page, the `iframe`'s [nested browsing context](#)'s `WindowProxy` object will proxy new `Window` objects for new `Document` objects, but the `src` attribute will not change.

The `name` attribute, if present, must be a [valid browsing context name](#). The given value is used to name the element's [nested browsing context](#) if present when that is created.



[Element/iframe#attr-sandbox](#)

Support in all current engines.

Firefox 17+ Safari 5+ Chrome 4+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 17+ Safari iOS 4.2+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android?

The `sandbox` attribute, when specified, enables a set of extra restrictions on any content hosted by the `iframe`. Its value must be an [unordered set of unique space-separated tokens](#) that are [ASCII case-insensitive](#). The allowed values are [allow-forms](#), [allow-modals](#), [allow-orientation-lock](#), [allow-pointer-lock](#), [allow-popups](#), [allow-popups-to-escape-sandbox](#), [allow-presentation](#), [allow-same-origin](#), [allow-scripts](#), [allow-top-navigation](#), [allow-top-navigation-by-user-activation](#), and [allow-downloads](#).

When the attribute is set, the content is treated as being from a unique [origin](#), forms, scripts, and various potentially annoying APIs are disabled, links are prevented from targeting other [browsing contexts](#), and plugins are secured. The [allow-same-origin](#) keyword causes the content to be treated as being from its real origin instead of forcing it into a unique origin; the [allow-top-navigation](#) keyword allows the content to [navigate](#) its [top-level browsing context](#); the [allow-top-navigation-by-user-activation](#) keyword behaves similarly but allows such [navigation](#) only when the browsing context's [active window](#) has [transient activation](#); and the [allow-forms](#), [allow-modals](#), [allow-orientation-lock](#), [allow-](#)

[pointer-lock](#), [allow-popups](#), [allow-presentation](#), [allow-scripts](#), and [allow-popups-to-escape-sandbox](#) keywords re-enable forms, modal dialogs, screen orientation lock, the pointer lock API, popups, the presentation API, scripts, and the creation of unsandboxed [auxiliary browsing contexts](#) respectively. The [allow-downloads](#) keyword allows content to perform downloads. [POINTERLOCK] [SCREENORIENTATION] [PRESENTATION]

The [allow-top-navigation](#) and [allow-top-navigation-by-user-activation](#) keywords must not both be specified, as doing so is redundant; only [allow-top-navigation](#) will have an effect in such non-conformant markup.

To allow [alert\(\)](#), [confirm\(\)](#), and [prompt\(\)](#) inside sandboxed content, both the [allow-modals](#) and [allow-same-origin](#) keywords need to be specified, and the loaded URL needs to be [same origin](#) with the [top-level origin](#). Without the [allow-same-origin](#) keyword, the content is always treated as cross-origin, and cross-origin content [cannot show simple dialogs](#).

Setting both the [allow-scripts](#) and [allow-same-origin](#) keywords together when the embedded page has the [same origin](#) as the page containing the [iframe](#) allows the embedded page to simply remove the [sandbox](#) attribute and then reload itself, effectively breaking out of the sandbox altogether.

These flags only take effect when the [nested browsing context](#) of the [iframe](#) element is [navigated](#). Removing them, or removing the entire [sandbox](#) attribute, has no effect on an already-loaded page.

Potentially hostile files should not be served from the same server as the file containing the [iframe](#) element. Sandboxing hostile content is of minimal help if an attacker can convince the user to just visit the hostile content directly, rather than in the [iframe](#). To limit the damage that can be caused by hostile HTML content, it should be served from a separate dedicated domain. Using a different domain ensures that scripts in the files are unable to attack the site, even if the user is tricked into visiting those pages directly, without the protection of the [sandbox](#) attribute.

When an [iframe](#) element's [sandbox](#) attribute is set or changed while it has a non-null [nested browsing context](#), the user agent must [parse the sandboxing directive](#) given the attribute's value and the [iframe](#) element's [iframe sandboxing flag set](#).

When an [iframe](#) element's [sandbox](#) attribute is removed while it has a non-null [nested browsing context](#), the user agent must empty the [iframe](#) element's [iframe sandboxing flag set](#).

In this example, some completely-unknown, potentially hostile, user-provided HTML content is embedded in a page. Because it is served from a separate domain, it is affected by all the normal cross-site restrictions. In addition, the embedded page has scripting disabled, plugins disabled, forms disabled, and it cannot navigate any frames or windows other than itself (or any frames or windows it itself embeds).

```
<p>We're not scared of you! Here is your content, unedited:</p>
<iframe sandbox src="https://usercontent.example.net/getusercontent.cgi?id=1234567890"></iframe>
```

It is important to use a separate domain so that if the attacker convinces the user to visit that page directly, the page doesn't run in the context of the site's origin, which would make the user vulnerable to any attack found in the page.

In this example, a gadget from another site is embedded. The gadget has scripting and forms enabled, and the origin sandbox restrictions are lifted, allowing the gadget to communicate with its originating server. The sandbox is still useful, however, as it disables plugins and popups, thus reducing the risk of the user being exposed to malware and other annoyances.

```
<iframe sandbox="allow-same-origin allow-forms allow-scripts"
       src="https://maps.example.com/embedded.html"></iframe>
```

Suppose a file A contained the following fragment:

```
<iframe sandbox="allow-same-origin allow-forms" src=B></iframe>
```

Suppose that file B contained an iframe also:

```
<iframe sandbox="allow-scripts" src=C></iframe>
```

Further, suppose that file C contained a link:

```
<a href=D>Link</a>
```

For this example, suppose all the files were served as [text/html](#).

Page C in this scenario has all the sandboxing flags set. Scripts are disabled, because the [iframe](#) in A has scripts disabled, and this overrides the [allow-scripts](#) keyword set on the [iframe](#) in B. Forms are also disabled, because the inner [iframe](#) (in B) does not have the [allow-forms](#) keyword set.

Suppose now that a script in A removes all the [sandbox](#) attributes in A and B. This would change nothing immediately. If the user clicked the link in C, loading page D into the [iframe](#) in B, page D would now act as if the [iframe](#) in B had the [allow-same-origin](#) and [allow-forms](#) keywords set, because that was the state of the [nested browsing context](#) in the [iframe](#) in A when page B was loaded.

Generally speaking, dynamically removing or changing the [sandbox](#) attribute is ill-advised, because it can make it quite hard to reason about what will be allowed and what will not.

The [allow](#) attribute, when specified, determines the [container policy](#) that will be used when the [permissions policy](#) for a [Document](#) in the [iframe](#)'s [nested browsing context](#) is initialized. Its value must be a [serialized permissions policy](#). [PERMISSIONSPOLICY]

In this example, an `iframe` is used to embed a map from an online navigation service. The `allow` attribute is used to enable the Geolocation API within the nested context.

```
<iframe src="https://maps.example.com/" allow="geolocation"></iframe>
```

The `allowfullscreen` attribute is a [boolean attribute](#). When specified, it indicates that [Document](#) objects in the `iframe` element's [nested browsing context](#) will be initialized with a [permissions policy](#) which allows the "fullscreen" feature to be used from any [origin](#). This is enforced by the [process permissions policy attributes](#) algorithm. [PERMISSIONSPOLICY]

Here, an `iframe` is used to embed a player from a video site. The `allowfullscreen` attribute is needed to enable the player to show its video fullscreen.

```
<article>
  <header>
    <p> <b>Fred Flintstone</b></p>
    <p><a href="/posts/3095182851" rel=bookmark>12:44</a> – <a href="#acl-3095182851">Edit</a></p>
    <p>Check out my new ride!</p>
    <iframe src="https://video.example.com/embed?id=92469812" allowfullscreen></iframe>
  </header>
</article>
```

Neither `allow` nor `allowfullscreen` can grant access to a feature in an `iframe` element's [nested browsing context](#) if the element's [node document](#) is not already allowed to use that feature.

To determine whether a [Document](#) object *document* is *allowed to use* the policy-controlled-feature *feature*, run these steps:

1. If *document's browsing context* is null, then return false.
2. If *document's browsing context's active document* is not *document*, then return false.
3. If the result of running [is feature enabled in document for origin](#) on *feature*, *document*, and *document's origin* is "Enabled", then return true.
4. Return false.

Because they only influence the [permissions policy](#) of the [nested browsing context's active document](#), the `allow` and `allowfullscreen` attributes only take effect when the [nested browsing context](#) of the `iframe` is [navigated](#). Adding or removing them has no effect on an already-loaded document.

The `iframe` element supports [dimension attributes](#) for cases where the embedded content has specific dimensions (e.g. ad units have well-defined dimensions).

An [iframe](#) element never has [fallback content](#), as it will always [create a new nested browsing context](#), regardless of whether the specified initial contents are successfully used.

The [referrerpolicy](#) attribute is a [referrer policy attribute](#). Its purpose is to set the [referrer policy](#) used when [processing the iframe attributes](#). [REFERRERPOLICY]

The [loading](#) attribute is a [lazy loading attribute](#). Its purpose is to indicate the policy for loading [iframe](#) elements that are outside the viewport.

When the [loading](#) attribute's state is changed to the [Eager](#) state, the user agent must run these steps:

1. Let *resumptionSteps* be the [iframe](#) element's [lazy load resumption steps](#).
 2. If *resumptionSteps* is null, then return.
 3. Set the [iframe](#)'s [lazy load resumption steps](#) to null.
 4. Invoke *resumptionSteps*.
-

Descendants of [iframe](#) elements represent nothing. (In legacy user agents that do not support [iframe](#) elements, the contents would be parsed as markup that could act as fallback content.)

The [HTML parser](#) treats markup inside [iframe](#) elements as text.



[HTMLIFrameElement/src](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLIFrameElement/srcdoc](#)

Support in all current engines.

Firefox 25+ Safari 6+ Chrome 20+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android25+Safari iOS6+Chrome Android25+WebView Android37+Samsung Internet1.5+Opera Android14+

The IDL attributes `src`, `srcdoc`, `name`, `sandbox`, and `allow` must [reflect](#) the respective content attributes of the same name.

The [supported tokens](#) for `sandbox`'s `DOMTokenList` are the allowed values defined in the `sandbox` attribute and supported by the user agent.

The `allowFullscreen` IDL attribute must [reflect](#) the [allowfullscreen](#) content attribute.



[HTMLIFrameElement/referrerPolicy](#)

Support in all current engines.

Firefox50+Safari14+Chrome53+

Opera38+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android50+Safari iOS14+Chrome Android53+WebView Android53+Samsung Internet6.0+Opera Android41+

The `referrerPolicy` IDL attribute must [reflect](#) the [referrerpolicy](#) content attribute, [limited to only known values](#).

The `loading` IDL attribute must [reflect](#) the [loading](#) content attribute, [limited to only known values](#).



[HTMLIFrameElement/contentDocument](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer8+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

The `contentDocument` IDL attribute, on getting, must return the [iframe](#) element's [content document](#).



[HTMLIFrameElement/contentWindow](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 8+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

The **contentWindow** IDL attribute must return the [WindowProxy](#) object of the [iframe](#) element's [nested browsing context](#), if its [nested browsing context](#) is non-null, or null otherwise.

Here is an example of a page using an [iframe](#) to include advertising from an advertising broker:

```
<iframe src="https://ads.example.com/?customerid=923513721&format=banner"
        width="468" height="60"></iframe>
```

4.8.6 The **embed** element

✓MDN

[Element/embed](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLEmbedElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content](#).

[Phrasing content.](#)

[Embedded content.](#)

[Interactive content.](#)

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [embedded content](#) is expected.

[Content model:](#)

[Nothing.](#)

[Tag omission in text/html:](#)

No [end tag](#).

[Content attributes:](#)

[Global attributes](#)

[**src**](#) — Address of the resource

[**type**](#) — Type of embedded resource

[**width**](#) — Horizontal dimension

[**height**](#) — Vertical dimension

Any other attribute that has no namespace (see prose).

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLEmbedElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute USVString src;
  [CEReactions] attribute DOMString type;
  [CEReactions] attribute DOMString width;
  [CEReactions] attribute DOMString height;
  Document? getSVGDocument();

  // also has obsolete members
};
```

Depending on the type of content instantiated by the [embed](#) element, the node may also support other interfaces.

The [embed](#) element provides an integration point for an external (typically non-HTML) application or interactive content.

The [`src`](#) attribute gives the [URL](#) of the resource being embedded. The attribute, if present, must contain a [valid non-empty URL potentially surrounded by spaces](#).

Authors should avoid referencing untrusted resources, as such a resource can be used to instantiate plugins or run scripts, even if the author has used features such as the Flash "allowScriptAccess" parameter.

If the [`itemprop`](#) attribute is specified on an [embed](#) element, then the [`src`](#) attribute must also be specified.

The [`type`](#) attribute, if present, gives the [MIME type](#) by which the plugin to instantiate is selected. The value must be a [valid MIME type string](#). If both the [`type`](#) attribute and the [`src`](#) attribute are present, then the [`type`](#) attribute must specify the same type as the [explicit Content-Type metadata](#) of the resource given by the [`src`](#) attribute.

While any of the following conditions are occurring, any [plugin](#) instantiated for the element must be removed, and the [embed](#) element [represents](#) nothing:

- The element has neither a [`src`](#) attribute nor a [`type`](#) attribute.
- The element has a [media element](#) ancestor.
- The element has an ancestor [`object`](#) element that is *not* showing its [fallback content](#).

An [embed](#) element is said to be *potentially active* when the following conditions are all met simultaneously:

- The element is [in a document](#) or was [in a document](#) the last time the [event loop](#) reached [step 1](#).
- The element's [node document](#) is [fully active](#).
- The element has either a [`src`](#) attribute set or a [`type`](#) attribute set (or both).
- The element's [`src`](#) attribute is either absent or its value is not the empty string.
- The element is not a descendant of a [media element](#).
- The element is not a descendant of an [`object`](#) element that is not showing its [fallback content](#).
- The element is [being rendered](#), or was [being rendered](#) the last time the [event loop](#) reached [step 1](#).

Whenever an [embed](#) element that was not [potentially active](#) becomes [potentially active](#), and whenever a [potentially active embed](#) element that is remaining [potentially active](#) and has its [`src`](#) attribute set, changed, or removed or its [`type`](#) attribute set, changed, or removed, the user

agent must [queue an element task](#) on the *embed task source* given the element to run [the embed element setup steps](#) for that element.

The *embed* element setup steps for a given [embed](#) element *element* are as follows:

1. If another [task](#) has since been queued to run [the embed element setup steps](#) for *element*, then return.
2. If *element* has a [src](#) attribute set, then:
 1. Let *url* be the result of [parsing](#) the value of *element*'s [src](#) attribute, relative to *element*'s [node document](#).
 2. If *url* is failure, then return.
 3. Let *request* be a new [request](#) whose [URL](#) is *url*, [client](#) is *element*'s [node document](#)'s [relevant settings object](#), [destination](#) is "embed", [credentials mode](#) is "include", [mode](#) is "navigate", and whose [use-URL-credentials flag](#) is set.
 4. [Fetch request](#).

Fetching the resource must [delay the load event](#) of *element*'s [node document](#).

To [process response](#) for the [response](#) *response*:

1. If another [task](#) has since been queued to run [the embed element setup steps](#) for *element*, then return.
2. If *response* is a [network error](#), then [fire an event](#) named [load](#) at *element*, and return.
3. Let *type* be the result of determining the [type of content](#) given *element* and *response*.
4. Switch on *type*:

`null`

1. [Display no plugin](#) for *element*.

[image/svg+xml](#)

1. If *element*'s [nested browsing context](#) is null, then [create a new nested browsing context](#) for *element*.
2. [Navigate](#) *element*'s [nested browsing context](#) to *response*, with [historyHandling](#) set to "replace" and the [source browsing context](#) set to *element*'s [node document](#)'s [browsing context](#).

[context](#).

element's [src](#) attribute does not get updated if the browsing context gets further navigated to other locations.

3. *element now [represents](#) its [nested browsing context](#).*

Otherwise

1. [Display a plugin](#) for *element*, given *type* and *response*.

3. Otherwise:

1. Let *type* be the value of *element's type* attribute.
2. If *type* is a type that a [plugin](#) supports, then [display a plugin](#) for *element* given *type*.
3. Otherwise, [display no plugin](#) for *element*.

To determine the *type of the content* given an [embed](#) element *element* and a [response](#) *response*, run the following steps:

1. If *element* has a [type](#) attribute, and that attribute's value is a type that a [plugin](#) supports, then return the value of the [type](#) attribute.
2. If the [path](#) component of *response*'s [url](#) matches a pattern that a [plugin](#) supports, then return the type that that plugin can handle.

For example, a plugin might say that it can handle URLs with [path](#) components that end with the four character string ".[swf](#)".

3. If *response* has [explicit Content-Type metadata](#), and that value is a type that a [plugin](#) supports, then return that value.
4. Return null.

It is intentional that the above algorithm allows *response* to have a non-[ok status](#). This allows servers to return data for plugins even with error responses (e.g., HTTP 500 Internal Server Error codes can still contain plugin data).

To [display a plugin](#) for an [embed](#) element *element*, given a string *type* and optionally a [response](#) *response*:

1. If *element*'s [nested browsing context](#) is not null, then:
 1. [Discard](#) *element*'s [nested browsing context](#).

2. Set *element*'s [nested browsing context](#) to null.
2. Find and instantiate an appropriate [plugin](#) based on *type*, replacing any previously-instantiated plugin for *element*. If *response* was given, forward it to the plugin.
3. *element* now [represents](#) this [plugin](#) instance.
4. Once the plugin, and *response* if given, are completely loaded, [queue an element task](#) on the [DOM manipulation task source](#) give *element* to [fire an event](#) named [load](#) at *element*.

To *display no plugin* for an [embed](#) element *element*:

1. If *element*'s [nested browsing context](#) is not null, then:
 1. [Discard](#) *element*'s [nested browsing context](#).
 2. Set *element*'s [nested browsing context](#) to null.
2. Display an indication that no [plugin](#) could be found for *element*, replacing any previously-instantiated plugin for *element*.
3. *element* now [represents](#) nothing.

The [embed](#) element has no [fallback content](#); its descendants are ignored.

Whenever an [embed](#) element that was [potentially active](#) stops being [potentially active](#), any [plugin](#) that had been instantiated for that element must be unloaded.

When a [plugin](#) is to be instantiated but the [sandboxed plugins browsing context flag](#) is set on the [embed](#) element's [node document](#)'s [active sandboxing flag set](#), then the user agent must not instantiate the [plugin](#), and must instead render the [embed](#) element in a manner that conveys that the [plugin](#) was disabled.

The [embed](#) element [potentially delays the load event](#).

Any namespace-less attribute other than [name](#), [align](#), [hspace](#), and [vspace](#) may be specified on the [embed](#) element, so long as its name is [XML-compatible](#) and contains no [ASCII upper alphas](#). These attributes are then passed as parameters to the [plugin](#).

All attributes in [HTML documents](#) get lowercased automatically, so the restriction on uppercase letters doesn't affect such documents.

The four exceptions are to exclude legacy attributes that have side-effects beyond just sending parameters to the [plugin](#).

The user agent should pass the names and values of all the attributes of the [embed](#) element that have no namespace to the [plugin](#) used, when one is instantiated.

The [HTMLEmbedElement](#) object representing the element must expose the scriptable interface of the [plugin](#) instantiated for the [embed](#) element, if any.

The [embed](#) element supports [dimension attributes](#).

The IDL attributes *src* and *type* each must [reflect](#) the respective content attributes of the same name.

Here's a way to embed a resource that requires a proprietary plugin, like Flash:

```
<embed src="catgame.swf">
```

If the user does not have the plugin (for example if the plugin vendor doesn't support the user's platform), then the user will be unable to use the resource.

To pass the plugin a parameter "quality" with the value "high", an attribute can be specified:

```
<embed src="catgame.swf" quality="high">
```

This would be equivalent to the following, when using an [object](#) element instead:

```
<object data="catgame.swf">
  <param name="quality" value="high">
</object>
```

4.8.7 The **object** element



[Element/object](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes



[HTMLObjectElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Embedded content.](#)

[Listed form-associated element.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [embedded content](#) is expected.

Content model:

Zero or more [param](#) elements, then, [transparent](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[data](#) — Address of the resource

[type](#) — Type of embedded resource

[name](#) — Name of [nested browsing context](#)

[form](#) — Associates the element with a [form](#) element

[width](#) — Horizontal dimension

[height](#) — Vertical dimension

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLObjectElement : HTMLElement {
  [HTMLConstructor] constructor();
```

```

[CEReactions] attribute USVString data;
[CEReactions] attribute DOMString type;
[CEReactions] attribute DOMString name;
readonly attribute HTMLFormElement? form;
[CEReactions] attribute DOMString width;
[CEReactions] attribute DOMString height;
readonly attribute Document? contentDocument;
readonly attribute WindowProxy? contentWindow;
Document? getSVGDocument();

readonly attribute boolean willValidate;
readonly attribute ValidityState validity;
readonly attribute DOMString validationMessage;
boolean checkValidity();
boolean reportValidity();
undefined setCustomValidity(DOMString error);

// also has obsolete members
};

```

Depending on the type of content instantiated by the object element, the node also supports other interfaces.

The object element can represent an external resource, which, depending on the type of the resource, will either be treated as an image, as a child browsing context, or as an external resource to be processed by a plugin.

The data attribute, if present, specifies the URL of the resource. If present, the attribute must be a valid non-empty URL potentially surrounded by spaces.

Authors should avoid referencing untrusted resources, as such a resource can be used to instantiate plugins or run scripts, even if the author has used features such as the Flash "allowScriptAccess" parameter.

The type attribute, if present, specifies the type of the resource. If present, the attribute must be a valid MIME type string.

At least one of either the data attribute or the type attribute must be present.

If the itemprop attribute is specified on an object element, then the data attribute must also be specified.

The name attribute, if present, must be a valid browsing context name. The given value is used to name the element's nested browsing context, if applicable, and if present when the element's nested browsing context is created.

Whenever one of the following conditions occur:

- the element is created,
- the element is popped off the [stack of open elements](#) of an [HTML parser](#) or [XML parser](#),
- the element is not on the [stack of open elements](#) of an [HTML parser](#) or [XML parser](#), and it is either [inserted into a document](#) or [removed from a document](#),
- the element's [node document](#) changes whether it is [fully active](#),
- one of the element's ancestor [object](#) elements changes to or from showing its [fallback content](#),
- the element's [classid](#) attribute is set, changed, or removed,
- the element's [classid](#) attribute is not present, and its [data](#) attribute is set, changed, or removed,
- neither the element's [classid](#) attribute nor its [data](#) attribute are present, and its [type](#) attribute is set, changed, or removed,
- the element changes from [being rendered](#) to not being rendered, or vice versa,

...the user agent must [queue an element task](#) on the [DOM manipulation task source](#) given the [object](#) element to run the following steps to (re)determine what the [object](#) element represents. This [task](#) being [queued](#) or actively running must [delay the load event](#) of the element's [node document](#).

1. If the user has indicated a preference that this [object](#) element's [fallback content](#) be shown instead of the element's usual behavior, then jump to the step below labeled *fallback*.

For example, a user could ask for the element's [fallback content](#) to be shown because that content uses a format that the user finds more accessible.

2. If the element has an ancestor [media element](#), or has an ancestor [object](#) element that is *not* showing its [fallback content](#), or if the element is not [in a document](#) whose [browsing context](#) is non-null, or if the element's [node document](#) is not [fully active](#), or if the element is still in the [stack of open elements](#) of an [HTML parser](#) or [XML parser](#), or if the element is not [being rendered](#), then jump to the step below labeled *fallback*.
3. If the [classid](#) attribute is present, and has a value that isn't the empty string, then: if the user agent can find a [plugin](#) suitable according to the value of the [classid](#) attribute, and [plugins aren't being sandboxed](#), then that [plugin should be used](#), and the value of the [data](#) attribute, if any, should be passed to the [plugin](#). If no suitable [plugin](#) can be found, or if the [plugin](#) reports an error, jump to the step below labeled *fallback*.
4. If the [data](#) attribute is present and its value is not the empty string, then:
 1. If the [type](#) attribute is present and its value is not a type that the user agent supports, and is not a type that the user agent can find a [plugin](#) for, then the user agent may jump to the step below labeled *fallback* without fetching the content to examine its real type.
 2. [Parse a URL](#) given the [data](#) attribute, relative to the element's [node document](#).

3. If that failed, [fire an event](#) named [error](#) at the element, then jump to the step below labeled *fallback*.
4. Let *request* be a new [request](#) whose [URL](#) is the [resulting URL record](#), [client](#) is the element's [node document](#)'s [relevant settings object](#), [destination](#) is "[object](#)", [credentials mode](#) is "[include](#)", [mode](#) is "[navigate](#)", and whose [use-URL-credentials flag](#) is set.
5. [Fetch request](#).

Fetching the resource must [delay the load event](#) of the element's [node document](#) until the [task](#) that is [queued](#) by the [networking task source](#) once the resource has been fetched (defined next) has been run.

6. If the resource is not yet available (e.g. because the resource was not available in the cache, so that loading the resource required making a request over the network), then jump to the step below labeled *fallback*. The [task](#) that is [queued](#) by the [networking task source](#) once the resource is available must restart this algorithm from this step. Resources can load incrementally; user agents may opt to consider a resource "available" whenever enough data has been obtained to begin processing the resource.
7. If the load failed (e.g. there was an HTTP 404 error, there was a DNS error), [fire an event](#) named [error](#) at the element, then jump to the step below labeled *fallback*.
8. Determine the *resource type*, as follows:

1. Let the *resource type* be unknown.
2. If the user agent is configured to strictly obey Content-Type headers for this resource, and the resource has [associated Content-Type metadata](#), then let the *resource type* be the type specified in [the resource's Content-Type metadata](#), and jump to the step below labeled *handler*.

This can introduce a vulnerability, wherein a site is trying to embed a resource that uses a particular plugin, but the remote site overrides that and instead furnishes the user agent with a resource that triggers a different plugin with different security characteristics.

3. If there is a [type](#) attribute present on the [object](#) element, and that attribute's value is not a type that the user agent supports, but it *is* a type that a [plugin](#) supports, then let the *resource type* be the type specified in that [type](#) attribute, and jump to the step below labeled *handler*.
4. Run the appropriate set of steps from the following list:

If the resource has [associated Content-Type metadata](#)

1. Let *binary* be false.
2. If the type specified in [the resource's Content-Type metadata](#) is "[text/plain](#)", and the result of applying the [rules for distinguishing if a resource is text or binary](#) to the resource is that the resource is not [text/plain](#), then set *binary* to true.
3. If the type specified in [the resource's Content-Type metadata](#) is "[application/octet-stream](#)", then set *binary* to true.
4. If *binary* is false, then let the *resource type* be the type specified in [the resource's Content-Type metadata](#), and jump to the step below labeled *handler*.
5. If there is a [type](#) attribute present on the [object](#) element, and its value is not [application/octet-stream](#), then run the following steps:
 1. If the attribute's value is a type that a [plugin](#) supports, or the attribute's value is a type that starts with "[image/](#)" that is not also an [XML MIME type](#), then let the *resource type* be the type specified in that [type](#) attribute.
 2. Jump to the step below labeled *handler*.

Otherwise, if the resource does not have [associated Content-Type metadata](#)

1. If there is a [type](#) attribute present on the [object](#) element, then let the *tentative type* be the type specified in that [type](#) attribute.

Otherwise, let *tentative type* be the [computed type of the resource](#).
2. If *tentative type* is not [application/octet-stream](#), then let *resource type* be *tentative type* and jump to the step below labeled *handler*.
5. If applying the [URL parser](#) algorithm to the [URL](#) of the specified resource (after any redirects) results in a [URL record](#) whose [path](#) component matches a pattern that a [plugin](#) supports, then let *resource*

type be the type that that plugin can handle.

For example, a plugin might say that it can handle resources with [path](#) components that end with the four character string ".swf".

It is possible for this step to finish, or for one of the substeps above to jump straight to the next step, with *resource type* still being unknown. In both cases, the next step will trigger fallback.

9. *Handler*: Handle the content as given by the first of the following cases that matches:

If the *resource type* is not a type that the user agent supports, but it *is* a type that a [plugin](#) supports

If the [object](#) element's [nested browsing context](#) is non-null, then it must be [discarded](#) and then set to null.

If [plugins are being sandboxed](#), then jump to the step below labeled *fallback*.

Otherwise, the user agent should [use the plugin that supports resource type](#) and pass the content of the resource to that [plugin](#). If the [plugin](#) reports an error, then jump to the step below labeled *fallback*.

If the *resource type* is an [XML MIME type](#), or if the *resource type* does not start with "**image/**"

If the [object](#) element's [nested browsing context](#) is null, then [create a new nested browsing context](#) for the element.

If the [URL](#) of the given resource does not [match about:blank](#), then [navigate](#) the element's [nested browsing context](#) to that resource, with [historyHandling](#) set to "[replace](#)" and the [source browsing context](#) set to the [object](#) element's [node document's browsing context](#). (The [data](#) attribute of the [object](#) element doesn't get updated if the browsing context gets further navigated to other locations.)

The [object](#) element [represents](#) its [nested browsing context](#).

If the *resource type* starts with "**image/**", and support for images has not been disabled

If the [object](#) element's [nested browsing context](#) is non-null, then it must be [discarded](#) and then set to null.

Apply the [image sniffing](#) rules to determine the type of the image.

The [object](#) element [represents](#) the specified image.

If the image cannot be rendered, e.g. because it is malformed or in an unsupported format, jump to the step below labeled *fallback*.

Otherwise

The given *resource type* is not supported. Jump to the step below labeled *fallback*.

If the previous step ended with the *resource type* being unknown, this is the case that is triggered.

10. The element's contents are not part of what the [object](#) element represents.
11. If the [object](#) element does not represent its [nested browsing context](#), then once the resource is completely loaded, [queue an element task](#) on the [DOM manipulation task source](#) given the [object](#) element to [fire an event](#) named [load](#) at the element.

If the element *does* represent its [nested browsing context](#), then an analogous task will be queued when the created [Document](#) is [completely finished loading](#).

12. Return.

5. If the [data](#) attribute is absent but the [type](#) attribute is present, and the user agent can find a [plugin](#) suitable according to the value of the [type](#) attribute, and [plugins aren't being sandboxed](#), then that [plugin should be used](#). If these conditions cannot be met, or if the [plugin](#) reports an error, jump to the step below labeled *fallback*. Otherwise return; once the plugin is completely loaded, [queue an element task](#) on the [DOM manipulation task source](#) given the [object](#) element to [fire an event](#) named [load](#) at the element.
6. *Fallback:* The [object](#) element [represents](#) the element's children, ignoring any leading [param](#) element children. This is the element's [fallback content](#). If the element has an instantiated [plugin](#), then unload it. If the element's [nested browsing context](#) is non-null, then it must be [discarded](#) and then set to null.

When the algorithm above instantiates a [plugin](#), the user agent should pass to the [plugin](#) used the names and values of all the attributes on the element, in the order they were added to the element, with the attributes added by the parser being ordered in source order, followed by a parameter named "PARAM" whose value is null, followed by all the names and values of [parameters](#) given by [param](#) elements that are children of the [object](#) element, in [tree order](#). If the [plugin](#) supports a scriptable interface, the [HTMLObjectElement](#) object representing the element should expose that interface. The [object](#) element [represents](#) the [plugin](#). The [plugin](#) is not a [nested browsing context](#).

Plugins are considered sandboxed for the purpose of an [object](#) element if the [sandboxed](#)

plugins browsing context flag is set on the [object](#) element's node document's active sandboxing flag set.

Due to the algorithm above, the contents of [object](#) elements act as fallback content, used only when referenced resources can't be shown (e.g. because it returned a 404 error). This allows multiple [object](#) elements to be nested inside each other, targeting multiple user agents with different capabilities, with the user agent picking the first one it supports.

The [object](#) element potentially delays the load event.

The [form](#) attribute is used to explicitly associate the [object](#) element with its form owner.

The [object](#) element supports dimension attributes.



[HTMLObjectElement/data](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLObjectElement/type](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLObjectElement/name](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The IDL attributes *data*, *type*, and *name* each must [reflect](#) the respective content attributes of the same name.



[HTMLObjectElement/contentDocument](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 8+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The *contentDocument* IDL attribute, on getting, must return the [object](#) element's [content document](#).



[HTMLObjectElement/contentWindow](#)

Support in all current engines.

Firefox 22+ Safari 13+ Chrome 53+

Opera No Edge 79+

Edge (Legacy) 17+ Internet Explorer No

Firefox Android 22+ Safari iOS 13+ Chrome Android 53+ WebView Android 53+ Samsung Internet 6.0+ Opera Android No

The *contentWindow* IDL attribute must return the [WindowProxy](#) object of the [object](#) element's [nested browsing context](#), if its [nested browsing context](#) is non-null; otherwise, it must return null.

The [willValidate](#), [validity](#), and [validationMessage](#) attributes, and the [checkValidity\(\)](#), [reportValidity\(\)](#), and [setCustomValidity\(\)](#) methods, are part of the [constraint validation API](#). The [form](#) IDL attribute is part of the element's forms API.

In this example, an HTML page is embedded in another using the [object](#) element.

```
<figure>
  <object data="clock.html"></object>
  <figcaption>My HTML Clock</figcaption>
</figure>
```

The following example shows how a plugin can be used in HTML (in this case the Flash plugin,

to show a video file). Fallback is provided for users who do not have Flash enabled, in this case using the [video](#) element to show the video for those using user agents that support [video](#), and finally providing a link to the video for those who have neither Flash nor a [video](#)-capable browser.

```
<p>Look at my video:  
<object type="application/x-shockwave-flash">  
  <param name=movie value="https://video.example.com/library/watch.swf">  
  <param name=allowfullscreen value=true>  
  <param name=flashvars value="https://video.example.com/vids/315981">  
  <video controls src="https://video.example.com/vids/315981">  
    <a href="https://video.example.com/vids/315981">View video</a>.  
  </video>  
</object>  
</p>
```

4.8.8 The **param** element



[Element/param](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLParamElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As a child of an [object](#) element, before any [flow content](#).

Content model:

Nothing.

Tag omission in text/html:

No end tag.

Content attributes:

Global attributes

name — Name of parameter

value — Value of parameter

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLParamElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute DOMString name;
  [CEReactions] attribute DOMString value;

  // also has obsolete members
};
```

The param element defines parameters for plugins invoked by object elements. It does not represent anything on its own.

The name attribute gives the name of the parameter.

The value attribute gives the value of the parameter.

Both attributes must be present. They may have any value.

If both attributes are present, and if the parent element of the param is an object element, then the element defines a *parameter* with the given name-value pair.

If either the name or value of a parameter defined by a param element that is the child of an object element that represents an instantiated plugin changes, and if that plugin is communicating with the user agent using an API that features the ability to update the plugin when the name or value of a parameter so changes, then the user agent must appropriately exercise that ability to notify the plugin of the change.

The IDL attributes ***name*** and ***value*** must both [reflect](#) the respective content attributes of the same name.

The following example shows how the [**param**](#) element can be used to pass a parameter to a plugin, in this case the O3D plugin.

```
<!DOCTYPE HTML>
<html lang="en">
  <head>
    <title>O3D Utah Teapot</title>
  </head>
  <body>
    <p>
      <object type="application/vnd.o3d.auto">
        <param name="o3d_features" value="FloatingPointTextures">
        
        <p>To see the teapot actually rendered by O3D on your
          computer, please download and install the <a
          href="http://code.google.com/apis/o3d/docs/gettingstarted.html#install">
        </object>
        <script src="o3d-teapot.js"></script>
      </p>
    </body>
  </html>
```

4.8.9 The **video** element

✓MDN

[Element/video](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 3+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLVideoElement](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Embedded content.](#)

If the element has a [**controls**](#) attribute: [Interactive content.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [embedded content](#) is expected.

Content model:

If the element has a [**src**](#) attribute: zero or more [track](#) elements, then [transparent](#), but with no [media element](#) descendants.

If the element does not have a [**src**](#) attribute: zero or more [source](#) elements, then zero or more [track](#) elements, then [transparent](#), but with no [media element](#) descendants.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[**src**](#) — Address of the resource

[**crossorigin**](#) — How the element handles crossorigin requests

[**poster**](#) — Poster frame to show prior to video playback

[**preload**](#) — Hints how much buffering the [media resource](#) will likely need

[**autoplay**](#) — Hint that the [media resource](#) can be started automatically when the page is loaded

[**playsinline**](#) — Encourage the user agent to display video content within the element's playback area

[**loop**](#) — Whether to loop the [media resource](#)

[muted](#) — Whether to mute the [media resource](#) by default

[controls](#) — Show user agent controls

[width](#) — Horizontal dimension

[height](#) — Vertical dimension

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLVideoElement : HTMLMediaElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute unsigned long width;
  [CEReactions] attribute unsigned long height;
  readonly attribute unsigned long videoWidth;
  readonly attribute unsigned long videoHeight;
  [CEReactions] attribute USVString poster;
  [CEReactions] attribute boolean playsInline;
};
```

A [video](#) element is used for playing videos or movies, and audio files with captions.

Content may be provided inside the [video](#) element. User agents should not show this content to the user; it is intended for older web browsers which do not support [video](#), so that legacy video plugins can be tried, or to show text to the users of these older browsers informing them of how to access the video contents.

In particular, this content is not intended to address accessibility concerns. To make video content accessible to the partially sighted, the blind, the hard-of-hearing, the deaf, and those with other physical or cognitive disabilities, a variety of features are available. Captions can be provided, either embedded in the video stream or as external files using the [track](#) element. Sign-language tracks can be embedded in the video stream. Audio descriptions can be embedded in the video stream or in text form using a [WebVTT file](#) referenced using the [track](#) element and synthesized into speech by the user agent. WebVTT can also be used to provide chapter titles. For users who would rather not use a media element at all, transcripts or other textual alternatives can be provided by simply linking to them in the prose near the [video](#) element. [\[WEBVTT\]](#)

The [video](#) element is a [media element](#) whose [media data](#) is ostensibly video data, possibly with associated audio data.

The `src`, `crossorigin`, `preload`, `autoplay`, `loop`, `muted`, and `controls` attributes are the attributes common to all media elements.

The `poster` attribute gives the [URL](#) of an image file that the user agent can show while no video data is available. The attribute, if present, must contain a [valid non-empty URL potentially surrounded by spaces](#).

If the specified resource is to be used, then, when the element is created or when the `poster` attribute is set, changed, or removed, the user agent must run the following steps to determine the element's *poster frame* (regardless of the value of the element's [show poster flag](#)):

1. If there is an existing instance of this algorithm running for this `video` element, abort that instance of this algorithm without changing the [poster frame](#).
2. If the `poster` attribute's value is the empty string or if the attribute is absent, then there is no [poster frame](#); return.
3. Parse the `poster` attribute's value relative to the element's [node document](#). If this fails, then there is no [poster frame](#); return.
4. Let `request` be a new `request` whose [URL](#) is the [resulting URL record](#), `client` is the element's [node document](#)'s [relevant settings object](#), `destination` is "image", [credentials mode](#) is "include", and whose [use-URL-credentials flag](#) is set.
5. Fetch `request`. This must [delay the load event](#) of the element's [node document](#).
6. If an image is thus obtained, the [poster frame](#) is that image. Otherwise, there is no [poster frame](#).

The image given by the `poster` attribute, the [poster frame](#), is intended to be a representative frame of the video (typically one of the first non-blank frames) that gives the user an idea of what the video is like.

The `playsinline` attribute is a [boolean attribute](#). If present, it serves as a hint to the user agent that the video ought to be displayed "inline" in the document by default, constrained to the element's playback area, instead of being displayed fullscreen or in an independent resizable window.

The absence of the `playsinline` attributes does not imply that the video will display fullscreen by default. Indeed, most user agents have chosen to play all videos inline by default, and in such user agents the `playsinline` attribute has no effect.

A `video` element represents what is given for the first matching condition in the list below:

When no video data is available (the element's `readyState` attribute is either [HAVE NOTHING](#), or [HAVE_METADATA](#) but no video data has yet been obtained at all, or the

element's `readyState` attribute is any subsequent value but the `media resource` does not have a video channel)

The `video` element `represents` its `poster frame`, if any, or else `transparent black` with no `intrinsic dimensions`.

When the `video` element is `paused`, the `current playback position` is the first frame of video, and the element's `show poster flag` is set

The `video` element `represents` its `poster frame`, if any, or else the first frame of the video.

When the `video` element is `paused`, and the frame of video corresponding to the `current playback position` is not available (e.g. because the video is seeking or buffering)

When the `video` element is neither `potentially playing` nor `paused` (e.g. when seeking or stalled)

The `video` element `represents` the last frame of the video to have been rendered.

When the `video` element is `paused`

The `video` element `represents` the frame of video corresponding to the `current playback position`.

Otherwise (the `video` element has a video channel and is `potentially playing`)

The `video` element `represents` the frame of video at the continuously increasing "`current position`". When the `current playback position` changes such that the last frame rendered is no longer the frame corresponding to the `current playback position` in the video, the new frame must be rendered.

Frames of video must be obtained from the video track that was `selected` when the `event loop` last reached `step 1`.

Which frame in a video stream corresponds to a particular playback position is defined by the video stream's format.

The `video` element also `represents` any `text track cues` whose `text track cue active flag` is set and whose `text track` is in the `showing` mode, and any audio from the `media resource`, at the `current playback position`.

Any audio associated with the `media resource` must, if played, be played synchronized with the `current playback position`, at the element's `effective media volume`. The user agent must play the audio from audio tracks that were `enabled` when the `event loop` last reached step 1.

In addition to the above, the user agent may provide messages to the user (such as "buffering", "no video loaded", "error", or more detailed information) by overlaying text or icons on the video or other areas of the element's playback area, or in another appropriate manner.

User agents that cannot render the video may instead make the element `represent` a link to an external video playback utility or to the video data itself.

When a `video` element's `media resource` has a video channel, the element provides a `paint source` whose width is the `media resource`'s `intrinsic width`, whose height is the `media resource`'s

[intrinsic height](#), and whose appearance is the frame of video corresponding to the [current playback position](#), if that is available, or else (e.g. when the video is seeking or buffering) its previous appearance, if any, or else (e.g. because the video is still loading the first frame) blackness.

[`video.videoWidth`](#)



[HTMLVideoElement/videoWidth](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

[`video.videoHeight`](#)



[HTMLVideoElement/videoHeight](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

These attributes return the intrinsic dimensions of the video, or zero if the dimensions are not known.

The *intrinsic width* and *intrinsic height* of the [media resource](#) are the dimensions of the resource in [CSS pixels](#) after taking into account the resource's dimensions, aspect ratio, clean aperture, resolution, and so forth, as defined for the format used by the resource. If an anamorphic format does not define how to apply the aspect ratio to the video data's dimensions to obtain the "correct" dimensions, then the user agent must apply the ratio by increasing one dimension and leaving the other unchanged.

The `videoWidth` IDL attribute must return the [intrinsic width](#) of the video in [CSS pixels](#). The `videoHeight` IDL attribute must return the [intrinsic height](#) of the video in [CSS pixels](#). If the element's `readyState` attribute is [HAVE NOTHING](#), then the attributes must return 0.

Whenever the [intrinsic width](#) or [intrinsic height](#) of the video changes (including, for example, because the [selected video track](#) was changed), if the element's `readyState` attribute is not

HAVE NOTHING, the user agent must queue a media element task given the media element to fire an event named resize at the media element.

The video element supports dimension attributes.

In the absence of style rules to the contrary, video content should be rendered inside the element's playback area such that the video content is shown centered in the playback area at the largest possible size that fits completely within it, with the video content's aspect ratio being preserved. Thus, if the aspect ratio of the playback area does not match the aspect ratio of the video, the video will be shown letterboxed or pillarboxed. Areas of the element's playback area that do not contain the video represent nothing.

In user agents that implement CSS, the above requirement can be implemented by using the style rule suggested in the Rendering section.

The intrinsic width of a video element's playback area is the intrinsic width of the poster frame, if that is available and the element currently represents its poster frame; otherwise, it is the intrinsic width of the video resource, if that is available; otherwise the intrinsic width is missing.

The intrinsic height of a video element's playback area is the intrinsic height of the poster frame, if that is available and the element currently represents its poster frame; otherwise it is the intrinsic height of the video resource, if that is available; otherwise the intrinsic height is missing.

The default object size is a width of 300 CSS pixels and a height of 150 CSS pixels. [CSSIMAGES]

User agents should provide controls to enable or disable the display of closed captions, audio description tracks, and other additional data associated with the video stream, though such features should, again, not interfere with the page's normal rendering.

User agents may allow users to view the video content in manners more suitable to the user, such as fullscreen or in an independent resizable window. User agents may even trigger such a viewing mode by default upon playing a video, although they should not do so when the playsinline attribute is specified. As with the other user interface features, controls to enable this should not interfere with the page's normal rendering unless the user agent is exposing a user interface. In such an independent viewing mode, however, user agents may make full user interfaces visible, even if the controls attribute is absent.

User agents may allow video playback to affect system features that could interfere with the user's experience; for example, user agents could disable screensavers while video playback is in progress.

The poster IDL attribute must reflect the poster content attribute.

The `playsInline` IDL attribute must [reflect](#) the `playsinline` content attribute.

This example shows how to detect when a video has failed to play correctly:

```
<script>
function failed(e) {
    // video playback failed - show a message saying why
    switch (e.target.error.code) {
        case e.target.error.MEDIA_ERR_ABORTED:
            alert('You aborted the video playback.');
            break;
        case e.target.error.MEDIA_ERR_NETWORK:
            alert('A network error caused the video download to fail part-way.');
            break;
        case e.target.error.MEDIA_ERR_DECODE:
            alert('The video playback was aborted due to a corruption problem or be
            break;
        case e.target.error.MEDIA_ERR_SRC_NOT_SUPPORTED:
            alert('The video could not be loaded, either because the server or netw
            break;
        default:
            alert('An unknown error occurred.');
            break;
    }
}
</script>
<p><video src="tgif.vid" autoplay controls onerror="failed(event)"></video></p>
<p><a href="tgif.vid">Download the video file</a>.</p>
```

4.8.10 The **audio** element



[Element/audio](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 3+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS Yes Chrome Android 18+ WebView Android 3+ Samsung Internet 1.0+ Opera Android Yes



[HTMLAudioElement](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Embedded content.](#)

If the element has a [**controls**](#) attribute: [Interactive content.](#)

If the element has a [**controls**](#) attribute: [Palpable content.](#)

Contexts in which this element can be used:

Where [embedded content](#) is expected.

Content model:

If the element has a [**src**](#) attribute: zero or more [track](#) elements, then [transparent](#), but with no [media element](#) descendants.

If the element does not have a [**src**](#) attribute: zero or more [source](#) elements, then zero or more [track](#) elements, then [transparent](#), but with no [media element](#) descendants.

Tag omission in text/html:

Neither tag is ommissible.

Content attributes:

[Global attributes](#)

[**src**](#) — Address of the resource

[**crossorigin**](#) — How the element handles crossorigin requests

[**preload**](#) — Hints how much buffering the [media resource](#) will likely need

[**autoplay**](#) — Hint that the [media resource](#) can be started automatically when the page is loaded

[**loop**](#) — Whether to loop the [media resource](#)

[**muted**](#) — Whether to mute the [media resource](#) by default

[**controls**](#) — Show user agent controls

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window,  
LegacyFactoryFunction=Audio(optional DOMString src)]  
interface HTMLAudioElement : HTMLMediaElement {  
    [HTMLConstructor] constructor();  
};
```

An [audio](#) element [represents](#) a sound or audio stream.

Content may be provided inside the [audio](#) element. User agents should not show this content to the user; it is intended for older web browsers which do not support [audio](#), so that legacy audio plugins can be tried, or to show text to the users of these older browsers informing them of how to access the audio contents.

In particular, this content is not intended to address accessibility concerns. To make audio content accessible to the deaf or to those with other physical or cognitive disabilities, a variety of features are available. If captions or a sign language video are available, the [video](#) element can be used instead of the [audio](#) element to play the audio, allowing users to enable the visual alternatives. Chapter titles can be provided to aid navigation, using the [track](#) element and a [WebVTT file](#). And, naturally, transcripts or other textual alternatives can be provided by simply linking to them in the prose near the [audio](#) element. [\[WEBVTT\]](#)

The [audio](#) element is a [media element](#) whose [media data](#) is ostensibly audio data.

The [src](#), [crossorigin](#), [preload](#), [autoplay](#), [loop](#), [muted](#), and [controls](#) attributes are [the attributes common to all media elements](#).

[audio = new Audio\(\[url \]\)](#)

✓MDN

[HTMLAudioElement/Audio](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 3+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns a new [audio](#) element, with the [src](#) attribute set to the value passed in the

argument, if applicable.

A legacy factory function is provided for creating [HTMLAudioElement](#) objects (in addition to the factory methods from DOM such as [createElement\(\): Audio\(src\)](#)). When invoked, the legacy factory function must perform the following steps:

1. Let *document* be the [current global object's associated Document](#).
2. Let *audio* be the result of [creating an element](#) given *document*, [audio](#), and the [HTML namespace](#).
3. [Set an attribute value](#) for *audio* using "preload" and "auto".
4. If *src* is given, then [set an attribute value](#) for *audio* using "src" and *src*. (This will [cause the user agent to invoke](#) the object's [resource selection algorithm](#) before returning.)
5. Return *audio*.

4.8.11 The **track** element



[Element/track](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 6+ Chrome Android 25+ WebView Android Yes Samsung Internet 1.5+ Opera Android?



[HTMLTrackElement](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 6+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12+

[Categories:](#)

None.

Contexts in which this element can be used:

As a child of a [media element](#), before any [flow content](#).

Content model:

Nothing.

Tag omission in text/html:

No [end tag](#).

Content attributes:

Global attributes

[kind](#) — The type of text track

[src](#) — Address of the resource

[srclang](#) — Language of the text track

[label](#) — User-visible label

[default](#) — Enable the track if no other [text track](#) is more suitable

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLTrackElement : HTMLElement {
  HTMLConstructor constructor();

  CEReactions attribute DOMString kind;
  CEReactions attribute USVString src;
  CEReactions attribute DOMString srclang;
  CEReactions attribute DOMString label;
  CEReactions attribute boolean default;

  const unsigned short NONE = 0;
  const unsigned short LOADING = 1;
  const unsigned short LOADED = 2;
  const unsigned short ERROR = 3;
  readonly attribute unsigned short readyState;

  readonly attribute TextTrack track;
};
```

The [track](#) element allows authors to specify explicit external timed [text tracks](#) for [media](#)

[elements](#). It does not [represent](#) anything on its own.

The *kind* attribute is an [enumerated attribute](#). The following table lists the keywords defined for this attribute. The keyword given in the first cell of each row maps to the state given in the second cell.

Keyword	State	Brief description
<i>subtitles</i>	<i>Subtitles</i>	Transcription or translation of the dialogue, suitable for when the sound is available but not understood (e.g. because the user does not understand the language of the media resource 's audio track). Overlaid on the video.
<i>captions</i>	<i>Captions</i>	Transcription or translation of the dialogue, sound effects, relevant musical cues, and other relevant audio information, suitable for when sound is unavailable or not clearly audible (e.g. because it is muted, drowned-out by ambient noise, or because the user is deaf). Overlaid on the video; labeled as appropriate for the hard-of-hearing.
<i>descriptions</i>	<i>Descriptions</i>	Textual descriptions of the video component of the media resource , intended for audio synthesis when the visual component is obscured, unavailable, or not usable (e.g. because the user is interacting with the application without a screen while driving, or because the user is blind). Synthesized as audio.
<i>chapters</i>	<i>Chapters metadata</i>	Tracks intended for use from script. Not displayed by the user agent.
<i>metadata</i>	<i>Metadata</i>	

The attribute may be omitted. The [missing value default](#) is the [subtitles](#) state. The [invalid value default](#) is the [metadata](#) state.

The *src* attribute gives the [URL](#) of the text track data. The value must be a [valid non-empty URL potentially surrounded by spaces](#). This attribute must be present.

If the element has a *src* attribute whose value is not the empty string and whose value, when the attribute was set, could be successfully [parsed](#) relative to the element's [node document](#), then the element's *track URL* is the [resulting URL string](#). Otherwise, the element's *track URL* is the empty string.

If the element's [track URL](#) identifies a WebVTT resource, and the element's *kind* attribute is not in the [chapters metadata](#) or [metadata](#) state, then the WebVTT file must be a [WebVTT file using cue text](#). [\[WEBVTT\]](#)

The *srclang* attribute gives the language of the text track data. The value must be a valid BCP 47 language tag. This attribute must be present if the element's *kind* attribute is in the [subtitles](#) state. [\[BCP47\]](#)

If the element has a *srclang* attribute whose value is not the empty string, then the element's

track language is the value of the attribute. Otherwise, the element has no [track language](#).

The **label** attribute gives a user-readable title for the track. This title is used by user agents when listing [subtitle](#), [caption](#), and [audio description](#) tracks in their user interface.

The value of the **label** attribute, if the attribute is present, must not be the empty string. Furthermore, there must not be two [track](#) element children of the same [media element](#) whose **kind** attributes are in the same state, whose **srclang** attributes are both missing or have values that represent the same language, and whose **label** attributes are again both missing or both have the same value.

If the element has a **label** attribute whose value is not the empty string, then the element's *track label* is the value of the attribute. Otherwise, the element's [track label](#) is an empty string.

The **default** attribute is a [boolean attribute](#), which, if specified, indicates that the track is to be enabled if the user's preferences do not indicate that another track would be more appropriate.

Each [media element](#) must have no more than one [track](#) element child whose **kind** attribute is in the [subtitles](#) or [captions](#) state and whose **default** attribute is specified.

Each [media element](#) must have no more than one [track](#) element child whose **kind** attribute is in the [description](#) state and whose **default** attribute is specified.

Each [media element](#) must have no more than one [track](#) element child whose **kind** attribute is in the [chapters metadata](#) state and whose **default** attribute is specified.

There is no limit on the number of [track](#) elements whose **kind** attribute is in the [metadata](#) state and whose **default** attribute is specified.

track.readyState

Returns the [text track readiness state](#), represented by a number from the following list:

track.NONE (0)

The [text track not loaded](#) state.

track.LOADING (1)

The [text track loading](#) state.

track.LOADED (2)

The [text track loaded](#) state.

`track.ERROR` (3)

The [text track failed to load](#) state.

`track.track`

Returns the [TextTrack](#) object corresponding to the [text track](#) of the [track](#) element.

The `readyState` attribute must return the numeric value corresponding to the [text track readiness state](#) of the [track](#) element's [text track](#), as defined by the following list:

`NONE` (numeric value 0)

The [text track not loaded](#) state.

`LOADING` (numeric value 1)

The [text track loading](#) state.

`LOADED` (numeric value 2)

The [text track loaded](#) state.

`ERROR` (numeric value 3)

The [text track failed to load](#) state.

The `track` IDL attribute must, on getting, return the [track](#) element's [text track](#)'s corresponding [TextTrack](#) object.



[HTMLTrackElement/src](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 6+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12+

The `src`, `srclang`, `label`, and `default` IDL attributes must [reflect](#) the respective content attributes of the same name. The `kind` IDL attribute must [reflect](#) the content attribute of the same name, [limited to only known values](#).

This video has subtitles in several languages:

```
<video src="brave.webm">
  <track kind=subtitles src=brave.en.vtt srclang=en label="English">
  <track kind=captions src=brave.en.hoh.vtt srclang=en label="English for the Deaf and Hard of Hearing">
```

```
<track kind=subtitles src=brave.fr.vtt srclang=fr lang=fr label="Français">
<track kind=subtitles src=brave.de.vtt srclang=de lang=de label="Deutsch">
</video>
```

(The `lang` attributes on the last two describe the language of the `label` attribute, not the language of the subtitles themselves. The language of the subtitles is given by the `srclang` attribute.)

4.8.12 Media elements

`HTMLMediaElement` objects (`audio` and `video`, in this specification) are simply known as *media elements*.



[HTMLMediaElement](#)

Support in all current engines.

Firefox 3.5+ Safari 1.3+ Chrome 1+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 11+

```
enum CanPlayTypeResult { "" /* empty string */, "maybe", "probably" };
typedef (MediaStream or MediaSource or Blob) MediaProvider;
```

```
[Exposed=Window]
interface HTMLMediaElement : HTMLElement {
```

```
    // error state
    readonly attribute MediaError? error;

    // network state
    [CEReactions] attribute USVString src;
    attribute MediaProvider? srcObject;
    readonly attribute USVString currentSrc;
    [CEReactions] attribute DOMString? crossOrigin;
    const unsigned short NETWORK_EMPTY = 0;
    const unsigned short NETWORK_IDLE = 1;
    const unsigned short NETWORK_LOADING = 2;
    const unsigned short NETWORK_NO_SOURCE = 3;
    readonly attribute unsigned short networkState;
    [CEReactions] attribute DOMString preload;
    readonly attribute TimeRanges buffered;
```

```

undefined load();
CanPlayTypeResult canPlayType(DOMString type);

// ready state
const unsigned short HAVE NOTHING = 0;
const unsigned short HAVE_METADATA = 1;
const unsigned short HAVE_CURRENT_DATA = 2;
const unsigned short HAVE_FUTURE_DATA = 3;
const unsigned short HAVE_ENOUGH_DATA = 4;
readonly attribute unsigned short readyState;
readonly attribute boolean seeking;

// playback state
attribute double currentTime;
undefined fastSeek(double time);
readonly attribute unrestricted double duration;
object getStartDate();
readonly attribute boolean paused;
attribute double defaultPlaybackRate;
attribute double playbackRate;
attribute boolean preservesPitch;
readonly attribute TimeRanges played;
readonly attribute TimeRanges seekable;
readonly attribute boolean ended;
[CEReactions] attribute boolean autoplay;
[CEReactions] attribute boolean loop;
Promise<undefined> play();
undefined pause();

// controls
[CEReactions] attribute boolean controls;
attribute double volume;
attribute boolean muted;
[CEReactions] attribute boolean defaultMuted;

// tracks
[SameObject] readonly attribute AudioTrackList audioTracks;
[SameObject] readonly attribute VideoTrackList videoTracks;
[SameObject] readonly attribute TextTrackList textTracks;
TextTrack addTextTrack(TextTrackKind kind, optional DOMString label = "", o
};


```

The *media element attributes*, [src](#), [crossorigin](#), [preload](#), [autoplay](#), [loop](#), [muted](#), and [controls](#), apply to all [media elements](#). They are defined in this section.

[Media elements](#) are used to present audio data, or video and audio data, to the user. This is referred to as *media data* in this section, since this section applies equally to [media elements](#) for

audio or for video. The term *media resource* is used to refer to the complete set of media data, e.g. the complete video file, or complete audio file.

A [media resource](#) can have multiple audio and video tracks. For the purposes of a [media element](#), the video data of the [media resource](#) is only that of the currently selected track (if any) as given by the element's [videoTracks](#) attribute when the [event loop](#) last reached [step 1](#), and the audio data of the [media resource](#) is the result of mixing all the currently enabled tracks (if any) given by the element's [audioTracks](#) attribute when the [event loop](#) last reached [step 1](#).

Both [audio](#) and [video](#) elements can be used for both audio and video. The main difference between the two is simply that the [audio](#) element has no playback area for visual content (such as video or captions), whereas the [video](#) element does.

Each [media element](#) has a unique *media element event task source*.

To queue a *media element task* with a [media element element](#) and a series of steps *steps*, [queue an element task](#) on the [media element's media element event task source](#) given *element* and *steps*.

4.8.12.1 Error codes



[MediaError](#)

Support in all current engines.

Firefox 4+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

[media.error](#)



[HTMLMediaElement/error](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns a [MediaError](#) object representing the current error state of the element.

Returns null if there is no error.

All [media elements](#) have an associated error status, which records the last error the element encountered since its [resource selection algorithm](#) was last invoked. The `error` attribute, on getting, must return the [MediaError](#) object created for this last error, or null if there has not been an error.

```
[Exposed=Window]
interface MediaError {
    const unsigned short MEDIA_ERR_ABORTED = 1;
    const unsigned short MEDIA_ERR_NETWORK = 2;
    const unsigned short MEDIA_ERR_DECODE = 3;
    const unsigned short MEDIA_ERR_SRC_NOT_SUPPORTED = 4;

    readonly attribute unsigned short code;
    readonly attribute DOMString message;
};
```

[`media.error.code`](#)

✓MDN

[MediaError/code](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns the current error's error code, from the list below.

[media.error.message](#)

MDN

[MediaError/message](#)

Support in all current engines.

Firefox 52+ Safari 15+ Chrome 59+

Opera 46+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 52+ Safari iOS 15+ Chrome Android 59+ WebView Android 59+ Samsung Internet 7.0+ Opera Android 43+

Returns a specific informative diagnostic message about the error condition encountered. The message and message format are not generally uniform across different user agents. If no such message is available, then the empty string is returned.

Every [MediaError](#) object has a *message*, which is a string, and a *code*, which is one of the following:

MEDIA_ERR_ABORTED (numeric value 1)

The fetching process for the [media resource](#) was aborted by the user agent at the user's request.

MEDIA_ERR_NETWORK (numeric value 2)

A network error of some description caused the user agent to stop fetching the [media resource](#), after the resource was established to be usable.

MEDIA_ERR_DECODE (numeric value 3)

An error of some description occurred while decoding the [media resource](#), after the resource was established to be usable.

MEDIA_ERR_SRC_NOT_SUPPORTED (numeric value 4)

The [media resource](#) indicated by the [src](#) attribute or [assigned media provider object](#) was not suitable.

To create a [MediaError](#), given an error code which is one of the above values, return a new [MediaError](#) object whose [code](#) is the given error code and whose [message](#) is a string containing any details the user agent is able to supply about the cause of the error condition, or the empty string if the user agent is unable to supply such details. This message string must not contain only the information already available via the supplied error code; for example, it must not simply be a translation of the code into a string format. If no additional information is available beyond that provided by the error code, the [message](#) must be set to the empty string.

The [code](#) getter steps are to return [this](#)'s [code](#).

The [message](#) getter steps are to return [this](#)'s [message](#).

4.8.12.2 Location of the media resource

The `src` content attribute on [media elements](#) gives the [URL](#) of the media resource (video, audio) to show. The attribute, if present, must contain a [valid non-empty URL potentially surrounded by spaces](#).

If the `itemprop` attribute is specified on the [media element](#), then the `src` attribute must also be specified.

The `crossorigin` content attribute on [media elements](#) is a [CORS settings attribute](#).

If a [media element](#) is created with a `src` attribute, the user agent must [immediately invoke the media element's resource selection algorithm](#).

If a `src` attribute of a [media element](#) is set or changed, the user agent must invoke the [media element's media element load algorithm](#). (*Removing the `src` attribute does not do this, even if there are `source` elements present.*)



[HTMLMediaElement/src](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The `src` IDL attribute on [media elements](#) must [reflect](#) the content attribute of the same name.



[HTMLMediaElement/crossOrigin](#)

Support in all current engines.

Firefox 22+ Safari 10+ Chrome 33+

Opera 20+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 22+ Safari iOS 10+ Chrome Android 33+ WebView Android 4.4.3+ Samsung Internet 2.0+ Opera Android 20+

The `crossOrigin` IDL attribute must [reflect](#) the [crossorigin](#) content attribute, [limited to only known values](#).

A *media provider object* is an object that can represent a [media resource](#), separate from a [URL](#). [MediaStream](#) objects, [MediaSource](#) objects, and [Blob](#) objects are all [media provider objects](#).

Each [media element](#) can have an *assigned media provider object*, which is a [media provider object](#). When a [media element](#) is created, it has no [assigned media provider object](#).

`media.srcObject [= source]`

MDN

[HTMLMediaElement/srcObject](#)

Support in one engine only.

Firefox 42+ Safari 11+ Chrome 52+

Opera 39+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 42+ Safari iOS 11+ Chrome Android 52+ WebView Android 52+ Samsung Internet 6.0+ Opera Android 41+

Allows the [media element](#) to be assigned a [media provider object](#).

`media.currentSrc`

MDN

[HTMLMediaElement/currentSrc](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [URL](#) of the current [media resource](#), if any.

Returns the empty string when there is no [media resource](#), or it doesn't have a [URL](#).

The *currentSrc* IDL attribute must initially be set to the empty string. Its value is changed by the [resource selection algorithm](#) defined below.

The *srcObject* IDL attribute, on getting, must return the element's [assigned media provider object](#), if any, or null otherwise. On setting, it must set the element's [assigned media provider object](#) to the new value, and then invoke the element's [media element load algorithm](#).

There are three ways to specify a [media resource](#): the [srcObject](#) IDL attribute, the [src](#)

content attribute, and [source](#) elements. The IDL attribute takes priority, followed by the content attribute, followed by the elements.

4.8.12.3 MIME types

A [media resource](#) can be described in terms of its *type*, specifically a [MIME type](#), in some cases with a `codecs` parameter. (Whether the `codecs` parameter is allowed or not depends on the MIME type.) [\[RFC6381\]](#)

Types are usually somewhat incomplete descriptions; for example "`video/mpeg`" doesn't say anything except what the container type is, and even a type like "`video/mp4; codecs="avc1.42E01E, mp4a.40.2"`" doesn't include information like the actual bitrate (only the maximum bitrate). Thus, given a type, a user agent can often only know whether it *might* be able to play media of that type (with varying levels of confidence), or whether it definitely *cannot* play media of that type.

A *type* that the user agent knows it cannot render is one that describes a resource that the user agent definitely does not support, for example because it doesn't recognize the container type, or it doesn't support the listed codecs.

The [MIME type "application/octet-stream"](#) with no parameters is never [a type that the user agent knows it cannot render](#). User agents must treat that type as equivalent to the lack of any explicit [Content-Type metadata](#) when it is used to label a potential [media resource](#).

Only the [MIME type "application/octet-stream"](#) with no parameters is special-cased here; if any parameter appears with it, it will be treated just like any other [MIME type](#). This is a deviation from the rule that unknown [MIME type](#) parameters should be ignored.

`media.canPlayType(type)`

MDN

[HTMLMediaElement/canPlayType](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 3+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the empty string (a negative response), "maybe", or "probably" based on how confident the user agent is that it can play media resources of the given type.

The `canPlayType(type)` method must return *the empty string* if *type* is [a type that the user agent knows it cannot render](#) or is the type "[application/octet-stream](#)"; it must return

"probably" if the user agent is confident that the type represents a [media resource](#) that it can render if used in with this [audio](#) or [video](#) element; and it must return *"maybe"* otherwise. Implementers are encouraged to return *"maybe"* unless the type can be confidently established as being supported or not. Generally, a user agent should never return *"probably"* for a type that allows the `codecs` parameter if that parameter is not present.

This script tests to see if the user agent supports a (fictional) new format to dynamically decide whether to use a [video](#) element or a plugin:

```
<section id="video">
<p><a href="playing-cats.nfv">Download video</a></p>
</section>
<script>
var videoSection = document.getElementById('video');
var videoElement = document.createElement('video');
var support = videoElement.canPlayType('video/x-new-fictional-format;codecs=');
if (support != "probably" && "New Fictional Video Plugin" in navigator.plugins)
    // not confident of browser support
    // but we have a plugin
    // so use plugin instead
    videoElement = document.createElement("embed");
} else if (support == "") {
    // no support from browser and no plugin
    // do nothing
    videoElement = null;
}
if (videoElement) {
    while (videoSection.hasChildNodes())
        videoSection.removeChild(videoSection.firstChild);
    videoElement.setAttribute("src", "playing-cats.nfv");
    videoSection.appendChild(videoElement);
}
</script>
```

The [type](#) attribute of the [source](#) element allows the user agent to avoid downloading resources that use formats it cannot render.

4.8.12.4 Network states

[**media.networkState**](#)



[HTMLMediaElement/networkState](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns the current state of network activity for the element, from the codes in the list below.

As [media elements](#) interact with the network, their current network activity is represented by the `networkState` attribute. On getting, it must return the current network state of the element, which must be one of the following values:

`NETWORK_EMPTY` (numeric value 0)

The element has not yet been initialized. All attributes are in their initial states.

`NETWORK_IDLE` (numeric value 1)

The element's [resource selection algorithm](#) is active and has selected a [resource](#), but it is not actually using the network at this time.

`NETWORK_LOADING` (numeric value 2)

The user agent is actively trying to download data.

`NETWORK_NO_SOURCE` (numeric value 3)

The element's [resource selection algorithm](#) is active, but it has not yet found a [resource](#) to use.

The [resource selection algorithm](#) defined below describes exactly when the `networkState` attribute changes value and what events fire to indicate changes in this state.

4.8.12.5 Loading the media resource

`media.load()`

✓MDN

[HTMLMediaElement/load](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Causes the element to reset and start selecting and loading a new [media resource](#) from

scratch.

All [media elements](#) have a *can autoplay flag*, which must begin in the true state, and a *delaying-the-load-event flag*, which must begin in the false state. While the [delaying-the-load-event flag](#) is true, the element must [delay the load event](#) of its document.

When the [`load\(\)`](#) method on a [media element](#) is invoked, the user agent must run the [media element load algorithm](#).

The *media element load algorithm* consists of the following steps.

1. Abort any already-running instance of the [resource selection algorithm](#) for this element.
2. Let *pending tasks* be a list of all [tasks](#) from the [media element's media element event task source](#) in one of the [task queues](#).
3. For each task in *pending tasks* that would [resolve pending play promises](#) or [reject pending play promises](#), immediately resolve or reject those promises in the order the corresponding tasks were queued.
4. Remove each [task](#) in *pending tasks* from its [task queue](#)

Basically, pending events and callbacks are discarded and promises in-flight to be resolved/rejected are resolved/rejected immediately when the media element starts loading a new resource.

5. If the [media element's networkState](#) is set to [NETWORK_LOADING](#) or [NETWORK_IDLE](#), [queue a media element task](#) given the [media element](#) to [fire an event](#) named [abort](#) at the [media element](#).
6. If the [media element's networkState](#) is not set to [NETWORK_EMPTY](#), then:
 1. [Queue a media element task](#) given the [media element](#) to [fire an event](#) named [emptied](#) at the [media element](#).
 2. If a fetching process is in progress for the [media element](#), the user agent should stop it.
 3. If the [media element's assigned media provider object](#) is a [MediaSource](#) object, then [detach](#) it.
 4. [Forget the media element's media-resource-specific tracks](#).
 5. If [readyState](#) is not set to [HAVE NOTHING](#), then set it to that state.
 6. If the [paused](#) attribute is false, then:
 1. Set the [paused](#) attribute to true.

2. Take pending play promises and reject pending play promises with the result and an ["AbortError" DOMException](#).
7. If [seeking](#) is true, set it to false.
8. Set the [current playback position](#) to 0.
Set the [official playback position](#) to 0.
If this changed the [official playback position](#), then queue a media element task given the [media element](#) to fire an event named [timeupdate](#) at the [media element](#).
9. Set the [timeline offset](#) to Not-a-Number (NaN).
10. Update the [duration](#) attribute to Not-a-Number (NaN).

The user agent [will not](#) fire a [durationchange](#) event for this particular change of the duration.

7. Set the [playbackRate](#) attribute to the value of the [defaultPlaybackRate](#) attribute.
8. Set the [error](#) attribute to null and the [can autoplay flag](#) to true.
9. Invoke the [media element's resource selection algorithm](#).
10. Playback of any previously playing [media resource](#) for this element stops.

The *resource selection algorithm* for a [media element](#) is as follows. This algorithm is always invoked as part of a [task](#), but one of the first steps in the algorithm is to return and continue running the remaining steps [in parallel](#). In addition, this algorithm interacts closely with the [event loop](#) mechanism; in particular, it has [synchronous sections](#) (which are triggered as part of the [event loop](#) algorithm). Steps in such sections are marked with ☒.

1. Set the element's [networkState](#) attribute to the [NETWORK_NO_SOURCE](#) value.
2. Set the element's [show poster flag](#) to true.
3. Set the [media element's delaying-the-load-event flag](#) to true (this [delays the load event](#)).
4. [Await a stable state](#), allowing the [task](#) that invoked this algorithm to continue. The [synchronous section](#) consists of all the remaining steps of this algorithm until the algorithm says the [synchronous section](#) has ended. (Steps in [synchronous sections](#) are marked with ☒.)
5. ☒ If the [media element's blocked-on-parser](#) flag is false, then [populate the list of pending text tracks](#).

6.
 - ☒ If the [media element](#) has an [assigned media provider object](#), then let *mode* be *object*.
 - ☒ Otherwise, if the [media element](#) has no [assigned media provider object](#) but has a [src](#) attribute, then let *mode* be *attribute*.
 - ☒ Otherwise, if the [media element](#) does not have an [assigned media provider object](#) and does not have a [src](#) attribute, but does have a [source](#) element child, then let *mode* be *children* and let *candidate* be the first such [source](#) element child in [tree order](#).
 - ☒ Otherwise the [media element](#) has no [assigned media provider object](#) and has neither a [src](#) attribute nor a [source](#) element child:
 1. ☒ Set the [networkState](#) to [NETWORK_EMPTY](#).
 2. ☒ Set the element's [delaying-the-load-event flag](#) to false. This stops [delaying the load event](#).
 3. End the [synchronous section](#) and return.
7. ☒ Set the [media element](#)'s [networkState](#) to [NETWORK_LOADING](#).
8. ☒ [Queue a media element task](#) given the [media element](#) to [fire an event](#) named [loadstart](#) at the [media element](#).
9. Run the appropriate steps from the following list:

If *mode* is *object*

1. ☒ Set the [currentSrc](#) attribute to the empty string.
2. End the [synchronous section](#), continuing the remaining steps [in parallel](#).
3. Run the [resource fetch algorithm](#) with the [assigned media provider object](#). If that algorithm returns without aborting *this* one, then the load failed.
4. *Failed with media provider*: Reaching this step indicates that the media resource failed to load. [Take pending play promises](#) and [queue a media element task](#) given the [media element](#) to run the [dedicated media source failure steps](#) with the result.
5. Wait for the [task](#) queued by the previous step to have executed.
6. Return. The element won't attempt to load another resource until this algorithm is triggered again.

If *mode* is *attribute*

1. ☒ If the [src](#) attribute's value is the empty string, then end the [synchronous](#)

[section](#), and jump down to the *failed with attribute* step below.

2. ☒ Let *urlString* and *urlRecord* be the [resulting URL string](#) and the [resulting URL record](#), respectively, that would have resulted from [parsing](#) the [URL](#) specified by the [src](#) attribute's value relative to the [media element's node document](#) when the [src](#) attribute was last changed.
3. ☒ If *urlString* was obtained successfully, set the [currentSrc](#) attribute to *urlString*.
4. End the [synchronous section](#), continuing the remaining steps [in parallel](#).
5. If *urlRecord* was obtained successfully, run the [resource fetch algorithm](#) with *urlRecord*. If that algorithm returns without aborting *this* one, then the load failed.
6. *Failed with attribute*: Reaching this step indicates that the media resource failed to load or that the given [URL](#) could not be [parsed](#). [Take pending play promises](#) and [queue a media element task](#) given the [media element](#) to run the [dedicated media source failure steps](#) with the result.
7. Wait for the [task](#) queued by the previous step to have executed.
8. Return. The element won't attempt to load another resource until this algorithm is triggered again.

Otherwise (*mode* is *children*)

1. ☒ Let *pointer* be a position defined by two adjacent nodes in the [media element](#)'s child list, treating the start of the list (before the first child in the list, if any) and end of the list (after the last child in the list, if any) as nodes in their own right. One node is the node before *pointer*, and the other node is the node after *pointer*. Initially, let *pointer* be the position between the *candidate* node and the next node, if there are any, or the end of the list, if it is the last node.

As [nodes are inserted](#) and [removed](#) into the [media element](#), *pointer* must be updated as follows:

If a new [node is inserted](#) between the two nodes that define *pointer*

Let *pointer* be the point between the node before *pointer* and the new node. In other words, insertions at *pointer* go after *pointer*.

If the node before *pointer* is removed

Let *pointer* be the point between the node after *pointer* and the node before the node after *pointer*. In other words, *pointer* doesn't move relative to the remaining nodes.

If the node after *pointer* is removed

Let *pointer* be the point between the node before *pointer* and the node after the node before *pointer*. Just as with the previous case, *pointer* doesn't move relative to the remaining nodes.

Other changes don't affect *pointer*.

2. \square *Process candidate*: If *candidate* does not have a [src](#) attribute, or if its [src](#) attribute's value is the empty string, then end the [synchronous section](#), and jump down to the *failed with elements* step below.
3. \square Let *urlString* and *urlRecord* be the [resulting URL string](#) and the [resulting URL record](#), respectively, that would have resulted from [parsing the URL](#) specified by *candidate*'s [src](#) attribute's value relative to the *candidate*'s [node document](#) when the [src](#) attribute was last changed.
4. \square If *urlString* was not obtained successfully, then end the [synchronous section](#), and jump down to the *failed with elements* step below.
5. \square If *candidate* has a [type](#) attribute whose value, when parsed as a [MIME type](#) (including any codecs described by the [codecs](#) parameter, for types that define that parameter), represents [a type that the user agent knows it cannot render](#), then end the [synchronous section](#), and jump down to the *failed with elements* step below.
6. \square Set the [currentSrc](#) attribute to *urlString*.
7. End the [synchronous section](#), continuing the remaining steps [in parallel](#).
8. Run the [resource fetch algorithm](#) with *urlRecord*. If that algorithm returns without aborting *this one*, then the load failed.
9. *Failed with elements*: [Queue a media element task](#) given the [media element](#) to [fire an event](#) named [error](#) at *candidate*.
10. [Await a stable state](#). The [synchronous section](#) consists of all the remaining steps of this algorithm until the algorithm says the [synchronous section](#) has ended. (Steps in [synchronous sections](#) are marked with \square .)
11. \square [Forget the media element's media-resource-specific tracks](#).
12. \square *Find next candidate*: Let *candidate* be null.
13. \square *Search loop*: If the node after *pointer* is the end of the list, then jump to the *waiting* step below.
14. \square If the node after *pointer* is a [source](#) element, let *candidate* be that element.

15. ☒ Advance *pointer* so that the node before *pointer* is now the node that was after *pointer*, and the node after *pointer* is the node after the node that used to be after *pointer*, if any.
16. ☒ If *candidate* is null, jump back to the *search loop* step. Otherwise, jump back to the *process candidate* step.
17. ☒ *Waiting*: Set the element's [networkState](#) attribute to the [NETWORK_NO_SOURCE](#) value.
18. ☒ Set the element's [show poster flag](#) to true.
19. ☒ Queue a [media element task](#) given the [media element](#) to set the element's [delaying-the-load-event flag](#) to false. This stops [delaying the load event](#).
20. End the [synchronous section](#), continuing the remaining steps [in parallel](#).
21. Wait until the node after *pointer* is a node other than the end of the list. (This step might wait forever.)
22. [Await a stable state](#). The [synchronous section](#) consists of all the remaining steps of this algorithm until the algorithm says the [synchronous section](#) has ended. (Steps in [synchronous sections](#) are marked with ☒.)
23. ☒ Set the element's [delaying-the-load-event flag](#) back to true (this [delays the load event](#) again, in case it hasn't been fired yet).
24. ☒ Set the [networkState](#) back to [NETWORK_LOADING](#).
25. ☒ Jump back to the *find next candidate* step above.

The *dedicated media source failure steps* with a list of promises *promises* are the following steps:

1. Set the [error](#) attribute to the result of [creating a MediaError](#) with [MEDIA_ERR_SRC_NOT_SUPPORTED](#).
2. [Forget the media element's media-resource-specific tracks](#).
3. Set the element's [networkState](#) attribute to the [NETWORK_NO_SOURCE](#) value.
4. Set the element's [show poster flag](#) to true.
5. [Fire an event](#) named [error](#) at the [media element](#).
6. [Reject pending play promises](#) with *promises* and a ["NotSupportedError"](#) [DOMException](#).

7. Set the element's [delaying-the-load-event flag](#) to false. This stops [delaying the load event](#).

The *resource fetch algorithm* for a [media element](#) and a given [URL record](#) or [media provider object](#) is as follows:

1. If the algorithm was invoked with [media provider object](#) or a [URL record](#) whose [blob URL entry](#) is a [blob URL entry](#) whose [object](#) is a [media provider object](#), then let *mode* be *local*. Otherwise let *mode* be *remote*.
2. If *mode* is *remote*, then let the *current media resource* be the resource given by the [URL record](#) passed to this algorithm; otherwise, let the *current media resource* be the resource given by the [media provider object](#). Either way, the *current media resource* is now the element's [media resource](#).
3. Remove all [media-resource-specific text tracks](#) from the [media element's list of pending text tracks](#), if any.
4. Run the appropriate steps from the following list:

If *mode* is *remote*

1. Optionally, run the following substeps. This is the expected behavior if the user agent intends to not attempt to fetch the resource until the user requests it explicitly (e.g. as a way to implement the [preload](#) attribute's [none](#) keyword).
 1. Set the [networkState](#) to [NETWORK_IDLE](#).
 2. [Queue a media element task](#) given the [media element](#) to [fire an event](#) named [suspend](#) at the element.
 3. [Queue a media element task](#) given the [media element](#) to set the element's [delaying-the-load-event flag](#) to false. This stops [delaying the load event](#).
 4. Wait for the task to be run.
 5. Wait for an [implementation-defined](#) event (e.g., the user requesting that the media element begin playback).
 6. Set the element's [delaying-the-load-event flag](#) back to true (this [delays the load event](#) again, in case it hasn't been fired yet).
 7. Set the [networkState](#) to [NETWORK_LOADING](#).
2. Let *destination* be "audio" if the [media element](#) is an [audio](#) element and to "video" otherwise.

Let `request` be the result of [creating a potential-CORS request](#) given *current media resource's URL record*, *destination*, and the *media element's crossorigin* content attribute value.

Set `request`'s [client](#) to the *media element*'s [node document](#)'s [relevant settings object](#).

[Fetch](#) `request`.

The *response*'s [unsafe response](#) obtained in this fashion, if any, contains the [media data](#). It can be [CORS-same-origin](#) or [CORS-cross-origin](#); this affects whether subtitles referenced in the [media data](#) are exposed in the API and, for [video](#) elements, whether a [canvas](#) gets tainted when the video is drawn on it.

The *media element stall timeout* is an [implementation-defined](#) length of time, which should be about three seconds. When a [media element](#) that is actively attempting to obtain [media data](#) has failed to receive any data for a duration equal to the [media element stall timeout](#), the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [stalled](#) at the element.

User agents may allow users to selectively block or slow [media data](#) downloads. When a [media element](#)'s download has been blocked altogether, the user agent must act as if it was stalled (as opposed to acting as if the connection was closed). The rate of the download may also be throttled automatically by the user agent, e.g. to balance the download with other connections sharing the same bandwidth.

User agents may decide to not download more content at any time, e.g. after buffering five minutes of a one hour media resource, while waiting for the user to decide whether to play the resource or not, while waiting for user input in an interactive resource, or when the user navigates away from the page. When a [media element](#)'s download has been suspended, the user agent must [queue a media element task](#) given the [media element](#) to set the [networkState](#) to [NETWORK_IDLE](#) and [fire an event](#) named [suspend](#) at the element. If and when downloading of the resource resumes, the user agent must [queue a media element task](#) given the [media element](#) to set the [networkState](#) to [NETWORK_LOADING](#). Between the queuing of these tasks, the load is suspended (so [progress](#) events don't fire, as described above).

The [preload](#) attribute provides a hint regarding how much buffering the author thinks is advisable, even in the absence of the [autoplay](#) attribute.

When a user agent decides to completely suspend a download, e.g., if it is waiting until the user starts playback before downloading any further

content, the user agent must [queue a media element task](#) given the [media element](#) to set the element's [delaying-the-load-event flag](#) to false. This stops [delaying the load event](#).

The user agent may use whatever means necessary to fetch the resource (within the constraints put forward by this and other specifications); for example, reconnecting to the server in the face of network errors, using HTTP range retrieval requests, or switching to a streaming protocol. The user agent must consider a resource erroneous only if it has given up trying to fetch it.

To determine the format of the [media resource](#), the user agent must use the [rules for sniffing audio and video specifically](#).

While the load is not suspended (see below), every 350ms ($\pm 200\text{ms}$) or for every byte received, whichever is *least* frequent, [queue a media element task](#) given the [media element](#) to [fire an event](#) named [progress](#) at the element.

The [networking task source tasks](#) to process the data as it is being fetched must each [immediately queue a media element task](#) given the [media element](#) to run the first appropriate steps from the [media data processing steps list](#) below. (A new task is used for this so that the work described below occurs relative to the appropriate [media element event task source](#) rather than using the [networking task source](#).)

When the [networking task source](#) has [queued](#) the last [task](#) as part of fetching the [media resource](#) (i.e. once the download has completed), if the fetching process completes without errors, including decoding the media data, and if all of the data is available to the user agent without network access, then, the user agent must move on to the *final step* below. This might never happen, e.g. when streaming an infinite resource such as web radio, or if the resource is longer than the user agent's ability to cache data.

While the user agent might still need network access to obtain parts of the [media resource](#), the user agent must remain on this step.

For example, if the user agent has discarded the first half of a video, the user agent will remain at this step even once the [playback has ended](#), because there is always the chance the user will seek back to the start. In fact, in this situation, once [playback has ended](#), the user agent will end up firing a [suspend](#) event, as described earlier.

Otherwise (*mode* is *local*)

The resource described by the *current media resource*, if any, contains the [media data](#). It is [CORS-same-origin](#).

If the *current media resource* is a raw data stream (e.g. from a [File](#) object), then to

determine the format of the [media resource](#), the user agent must use the [rules for sniffing audio and video specifically](#). Otherwise, if the data stream is pre-decoded, then the format is the format given by the relevant specification.

Whenever new data for the *current media resource* becomes available, [queue a media element task](#) given the [media element](#) to run the first appropriate steps from the [media data processing steps list](#) below.

When the *current media resource* is permanently exhausted (e.g. all the bytes of a [Blob](#) have been processed), if there were no decoding errors, then the user agent must move on to the *final step* below. This might never happen, e.g. if the *current media resource* is a [MediaStream](#).

The *media data processing steps list* is as follows:

If the [media data](#) cannot be fetched at all, due to network errors, causing the user agent to give up trying to fetch the resource

If the [media data](#) can be fetched but is found by inspection to be in an unsupported format, or can otherwise not be rendered at all

DNS errors, HTTP 4xx and 5xx errors (and equivalents in other protocols), and other fatal network errors that occur before the user agent has established whether the *current media resource* is usable, as well as the file using an unsupported container format, or using unsupported codecs for all the data, must cause the user agent to execute the following steps:

1. The user agent should cancel the fetching process.
2. Abort this subalgorithm, returning to the [resource selection algorithm](#).

If the [media resource](#) is found to have an audio track

1. Create an [AudioTrack](#) object to represent the audio track.
2. Update the [media element's audioTracks attribute's AudioTrackList object](#) with the new [AudioTrack](#) object.
3. Let *enable* be *unknown*.
4. If either the [media resource](#) or the [URL](#) of the *current media resource* indicate a particular set of audio tracks to enable, or if the user agent has information that would facilitate the selection of specific audio tracks to improve the user's experience, then: if this audio track is one of the ones to enable, then set *enable* to *true*, otherwise, set *enable* to *false*.

This could be triggered by [media fragment syntax](#), but it could also be triggered e.g. by the user agent selecting a 5.1 surround sound audio track over a stereo audio track.

5. If *enable* is still *unknown*, then, if the [media element](#) does not yet have an [enabled](#) audio track, then set *enable* to *true*, otherwise, set *enable* to *false*.
6. If *enable* is *true*, then enable this audio track, otherwise, do not enable this audio track.
7. [Fire an event](#) named [addtrack](#) at this [AudioTrackList](#) object, using [TrackEvent](#), with the [track](#) attribute initialized to the new [AudioTrack](#) object.

If the [media resource](#) is found to have a video track

1. Create a [VideoTrack](#) object to represent the video track.
2. Update the [media element](#)'s [videoTracks](#) attribute's [VideoTrackList](#) object with the new [VideoTrack](#) object.
3. Let *enable* be *unknown*.
4. If either the [media resource](#) or the [URL](#) of the *current media resource* indicate a particular set of video tracks to enable, or if the user agent has information that would facilitate the selection of specific video tracks to improve the user's experience, then: if this video track is the first such video track, then set *enable* to *true*, otherwise, set *enable* to *false*.

This could again be triggered by [media fragment syntax](#).

5. If *enable* is still *unknown*, then, if the [media element](#) does not yet have a [selected](#) video track, then set *enable* to *true*, otherwise, set *enable* to *false*.
6. If *enable* is *true*, then select this track and unselect any previously selected video tracks, otherwise, do not select this video track. If other tracks are unselected, then [a change event will be fired](#).
7. [Fire an event](#) named [addtrack](#) at this [VideoTrackList](#) object, using [TrackEvent](#), with the [track](#) attribute initialized to the new [VideoTrack](#) object.

Once enough of the [media data](#) has been fetched to determine the duration of the [media resource](#), its dimensions, and other metadata

This indicates that the resource is usable. The user agent must follow these substeps:

1. [Establish the media timeline](#) for the purposes of the [current playback position](#) and the [earliest possible position](#), based on the [media data](#).
2. Update the [timeline offset](#) to the date and time that corresponds to the zero

time in the [media timeline](#) established in the previous step, if any. If no explicit time and date is given by the [media resource](#), the [timeline offset](#) must be set to Not-a-Number (NaN).

3. Set the [current playback position](#) and the [official playback position](#) to the [earliest possible position](#).
4. Update the [duration](#) attribute with the time of the last frame of the resource, if known, on the [media timeline](#) established above. If it is not known (e.g. a stream that is in principle infinite), update the [duration](#) attribute to the value positive Infinity.

The user agent [will queue a media element task](#) given the [media element](#) to [fire an event](#) named [durationchange](#) at the element at this point.

5. For [video](#) elements, set the [videoWidth](#) and [videoHeight](#) attributes, and [queue a media element task](#) given the [media element](#) to [fire an event](#) named [resize](#) at the [media element](#).

Further [resize](#) events will be fired if the dimensions subsequently change.

6. Set the [readyState](#) attribute to [HAVE_METADATA](#).

A [loadedmetadata](#) DOM event [will be fired](#) as part of setting the [readyState](#) attribute to a new value.

7. Let *jumped* be false.
8. If the [media element's default playback start position](#) is greater than zero, then [seek](#) to that time, and let *jumped* be true.
9. Let the [media element's default playback start position](#) be zero.
10. Let the *initial playback position* be zero.
11. If either the [media resource](#) or the [URL](#) of the *current media resource* indicate a particular start time, then set the *initial playback position* to that time and, if *jumped* is still false, [seek](#) to that time.

For example, with media formats that support [media fragment syntax](#), the [fragment](#) can be used to indicate a start position.

12. If there is no [enabled](#) audio track, then enable an audio track. This [will cause a change event to be fired](#).
13. If there is no [selected](#) video track, then select a video track. This [will cause a change event to be fired](#).

Once the `readyState` attribute reaches `HAVE_CURRENT_DATA`, after the `loadeddata` event has been fired, set the element's `delaying-the-load-event flag` to false. This stops `delaying the load event`.

A user agent that is attempting to reduce network usage while still fetching the metadata for each `media resource` would also stop buffering at this point, following the rules described previously, which involve the `networkState` attribute switching to the `NETWORK_IDLE` value and a `suspend` event firing.

The user agent is *required* to determine the duration of the `media resource` and go through this step before playing.

Once the entire `media resource` has been fetched (but potentially before any of it has been decoded)

Fire an event named `progress` at the `media element`.

Set the `networkState` to `NETWORK_IDLE` and fire an event named `suspend` at the `media element`.

If the user agent ever discards any `media data` and then needs to resume the network activity to obtain it again, then it must queue a media element task given the `media element` to set the `networkState` to `NETWORK_LOADING`.

If the user agent can keep the `media resource` loaded, then the algorithm will continue to its *final step* below, which aborts the algorithm.

If the connection is interrupted after some `media data` has been received, causing the user agent to give up trying to fetch the resource

Fatal network errors that occur after the user agent has established whether the *current media resource* is usable (i.e. once the `media element`'s `readyState` attribute is no longer `HAVE NOTHING`) must cause the user agent to execute the following steps:

1. The user agent should cancel the fetching process.
2. Set the `error` attribute to the result of creating a `MediaError` with `MEDIA_ERR_NETWORK`.
3. Set the element's `networkState` attribute to the `NETWORK_IDLE` value.
4. Set the element's `delaying-the-load-event flag` to false. This stops `delaying the load event`.
5. Fire an event named `error` at the `media element`.

6. Abort the overall [resource selection algorithm](#).

If the [media data](#) is corrupted

Fatal errors in decoding the [media data](#) that occur after the user agent has established whether the *current media resource* is usable (i.e. once the [media element](#)'s [readyState](#) attribute is no longer [HAVE NOTHING](#)) must cause the user agent to execute the following steps:

1. The user agent should cancel the fetching process.
2. Set the [error](#) attribute to the result of [creating a MediaError](#) with [MEDIA_ERR_DECODE](#).
3. Set the element's [networkState](#) attribute to the [NETWORK_IDLE](#) value.
4. Set the element's [delaying-the-load-event flag](#) to false. This stops [delaying the load event](#).
5. [Fire an event](#) named [error](#) at the [media element](#).
6. Abort the overall [resource selection algorithm](#).

If the [media data](#) fetching process is aborted by the user

The fetching process is aborted by the user, e.g. because the user pressed a "stop" button, the user agent must execute the following steps. These steps are not followed if the [load\(\)](#) method itself is invoked while these steps are running, as the steps above handle that particular kind of abort.

1. The user agent should cancel the fetching process.
2. Set the [error](#) attribute to the result of [creating a MediaError](#) with [MEDIA_ERR_ABORTED](#).
3. [Fire an event](#) named [abort](#) at the [media element](#).
4. If the [media element](#)'s [readyState](#) attribute has a value equal to [HAVE NOTHING](#), set the element's [networkState](#) attribute to the [NETWORK_EMPTY](#) value, set the element's [show poster flag](#) to true, and [fire an event](#) named [emptied](#) at the element.

Otherwise, set the element's [networkState](#) attribute to the [NETWORK_IDLE](#) value.

5. Set the element's [delaying-the-load-event flag](#) to false. This stops [delaying the load event](#).

6. Abort the overall [resource selection algorithm](#).

If the [media data](#) can be fetched but has non-fatal errors or uses, in part, codecs that are unsupported, preventing the user agent from rendering the content completely correctly but not preventing playback altogether

The server returning data that is partially usable but cannot be optimally rendered must cause the user agent to render just the bits it can handle, and ignore the rest.

If the [media resource](#) is found to declare a [media-resource-specific text track](#) that the user agent supports

If the [media data](#) is [CORS-same-origin](#), run the [steps to expose a media-resource-specific text track](#) with the relevant data.

Cross-origin videos do not expose their subtitles, since that would allow attacks such as hostile sites reading subtitles from confidential videos on a user's intranet.

5. *Final step:* If the user agent ever reaches this step (which can only happen if the entire resource gets loaded and kept available): abort the overall [resource selection algorithm](#).

When a [media element](#) is to *forget the media element's media-resource-specific tracks*, the user agent must remove from the [media element](#)'s [list of text tracks](#) all the [media-resource-specific text tracks](#), then empty the [media element](#)'s [audioTracks](#) attribute's [AudioTrackList](#) object, then empty the [media element](#)'s [videoTracks](#) attribute's [VideoTrackList](#) object. No events (in particular, no [removetrack](#) events) are fired as part of this; the [error](#) and [emptied](#) events, fired by the algorithms that invoke this one, can be used instead.

The [preload](#) attribute is an [enumerated attribute](#). The following table lists the keywords and states for the attribute — the keywords in the left column map to the states in the cell in the second column on the same row as the keyword. The attribute can be changed even once the [media resource](#) is being buffered or played; the descriptions in the table below are to be interpreted with that in mind.

Keyword	State	Brief description
none	None	Hints to the user agent that either the author does not expect the user to need the media resource, or that the server wants to minimize unnecessary traffic. This state does not provide a hint regarding how aggressively to actually download the media resource if buffering starts anyway (e.g. once the user hits "play").
metadata	Metadata	Hints to the user agent that the author does not expect the user to need the media resource, but that fetching the resource metadata (dimensions, track list, duration, etc.), and maybe even the first few frames, is reasonable. If the user agent precisely fetches no more than the metadata, then the media element will end up with its readyState attribute set to HAVE_METADATA ; typically though, some frames will be

Keyword	State	Brief description
		obtained as well and it will probably be HAVE_CURRENT_DATA or HAVE_FUTURE_DATA . When the media resource is playing, hints to the user agent that bandwidth is to be considered scarce, e.g. suggesting throttling the download so that the media data is obtained at the slowest possible rate that still maintains consistent playback.
<code>auto</code>	<i>Automatic</i>	Hints to the user agent that the user agent can put the user's needs first without risk to the server, up to and including optimistically downloading the entire resource.

The empty string is also a valid keyword, and maps to the [Automatic](#) state. The attribute's [missing value default](#) and [invalid value default](#) are [implementation-defined](#), though the [Metadata](#) state is suggested as a compromise between reducing server load and providing an optimal user experience.

Authors might switch the attribute from "[none](#)" or "[metadata](#)" to "[auto](#)" dynamically once the user begins playback. For example, on a page with many videos this might be used to indicate that the many videos are not to be downloaded unless requested, but that once one *is* requested it is to be downloaded aggressively.

The [preload](#) attribute is intended to provide a hint to the user agent about what the author thinks will lead to the best user experience. The attribute may be ignored altogether, for example based on explicit user preferences or based on the available connectivity.

The [preload](#) IDL attribute must [reflect](#) the content attribute of the same name, [limited to only known values](#).

The [autoplay](#) attribute can override the [preload](#) attribute (since if the media plays, it naturally has to buffer first, regardless of the hint given by the [preload](#) attribute). Including both is not an error, however.

[`media.buffered`](#)



[HTMLMediaElement/buffered](#)

Support in all current engines.

Firefox 4+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns a [TimeRanges](#) object that represents the ranges of the [media resource](#) that the user agent has buffered.

The **`buffered`** attribute must return a new static [normalized TimeRanges object](#) that represents the ranges of the [media resource](#), if any, that the user agent has buffered, at the time the attribute is evaluated. User agents must accurately determine the ranges available, even for media streams where this can only be determined by tedious inspection.

Typically this will be a single range anchored at the zero point, but if, e.g. the user agent uses HTTP range requests in response to seeking, then there could be multiple ranges.

User agents may discard previously buffered data.

Thus, a time position included within a range of the objects returned by the **`buffered`** attribute at one time can end up being not included in the range(s) of objects returned by the same attribute at later times.

Returning a new object each time is a bad pattern for attribute getters and is only enshrined here as it would be costly to change it. It is not to be copied to new APIs.

4.8.12.6 Offsets into the media resource

`media.duration`

✓MDN

[HTMLMediaElement/duration](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the length of the [media resource](#), in seconds, assuming that the start of the [media resource](#) is at time zero.

Returns NaN if the duration isn't available.

Returns Infinity for unbounded streams.

`media.currentTime [= value]`

✓MDN

[HTMLMediaElement/currentTime](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [official playback position](#), in seconds.

Can be set, to seek to the given time.

A [media resource](#) has a *media timeline* that maps times (in seconds) to positions in the [media resource](#). The origin of a timeline is its earliest defined position. The duration of a timeline is its last defined position.

Establishing the media timeline: if the [media resource](#) somehow specifies an explicit timeline whose origin is not negative (i.e. gives each frame a specific time offset and gives the first frame a zero or positive offset), then the [media timeline](#) should be that timeline. (Whether the [media resource](#) can specify a timeline or not depends on the [media resource's](#) format.) If the [media resource](#) specifies an explicit start time *and date*, then that time and date should be considered the zero point in the [media timeline](#); the [timeline offset](#) will be the time and date, exposed using the [getStartDate\(\)](#) method.

If the [media resource](#) has a discontinuous timeline, the user agent must extend the timeline used at the start of the resource across the entire resource, so that the [media timeline](#) of the [media resource](#) increases linearly starting from the [earliest possible position](#) (as defined below), even if the underlying [media data](#) has out-of-order or even overlapping time codes.

For example, if two clips have been concatenated into one video file, but the video format exposes the original times for the two clips, the video data might expose a timeline that goes, say, 00:15..00:29 and then 00:05..00:38. However, the user agent would not expose those times; it would instead expose the times as 00:15..00:29 and 00:29..01:02, as a single video.

(This
is a
tracking
vector.)

In the rare case of a [media resource](#) that does not have an explicit timeline, the zero time on the [media timeline](#) should correspond to the first frame of the [media resource](#). In the even rarer case of a [media resource](#) with no explicit timings of any kind, not even frame durations, the user agent must itself determine the time for each frame in an [implementation-defined](#) manner.

An example of a file format with no explicit timeline but with explicit frame durations is the Animated GIF format. An example of a file format with no explicit timings at all is the JPEG-push format ([multipart/x-mixed-replace](#) with JPEG frames, often used as the format for MJPEG streams).

If, in the case of a resource with no timing information, the user agent will nonetheless be able to seek to an earlier point than the first frame originally provided by the server, then the zero

time should correspond to the earliest seekable time of the [media resource](#); otherwise, it should correspond to the first frame received from the server (the point in the [media resource](#) at which the user agent began receiving the stream).

At the time of writing, there is no known format that lacks explicit frame time offsets yet still supports seeking to a frame before the first frame sent by the server.

Consider a stream from a TV broadcaster, which begins streaming on a sunny Friday afternoon in October, and always sends connecting user agents the media data on the same media timeline, with its zero time set to the start of this stream. Months later, user agents connecting to this stream will find that the first frame they receive has a time with millions of seconds. The [getStartDate\(\)](#) method would always return the date that the broadcast started; this would allow controllers to display real times in their scrubber (e.g. "2:30pm") rather than a time relative to when the broadcast began ("8 months, 4 hours, 12 minutes, and 23 seconds").

Consider a stream that carries a video with several concatenated fragments, broadcast by a server that does not allow user agents to request specific times but instead just streams the video data in a predetermined order, with the first frame delivered always being identified as the frame with time zero. If a user agent connects to this stream and receives fragments defined as covering timestamps 2010-03-20 23:15:00 UTC to 2010-03-21 00:05:00 UTC and 2010-02-12 14:25:00 UTC to 2010-02-12 14:35:00 UTC, it would expose this with a [media timeline](#) starting at 0s and extending to 3,600s (one hour). Assuming the streaming server disconnected at the end of the second clip, the [duration](#) attribute would then return 3,600. The [getStartDate\(\)](#) method would return a [Date](#) object with a time corresponding to 2010-03-20 23:15:00 UTC. However, if a different user agent connected five minutes later, *it* would (presumably) receive fragments covering timestamps 2010-03-20 23:20:00 UTC to 2010-03-21 00:05:00 UTC and 2010-02-12 14:25:00 UTC to 2010-02-12 14:35:00 UTC, and would expose this with a [media timeline](#) starting at 0s and extending to 3,300s (fifty five minutes). In this case, the [getStartDate\(\)](#) method would return a [Date](#) object with a time corresponding to 2010-03-20 23:20:00 UTC.

In both of these examples, the [seekable](#) attribute would give the ranges that the controller would want to actually display in its UI; typically, if the servers don't support seeking to arbitrary times, this would be the range of time from the moment the user agent connected to the stream up to the latest frame that the user agent has obtained; however, if the user agent starts discarding earlier information, the actual range might be shorter.

In any case, the user agent must ensure that the [earliest possible position](#) (as defined below) using the established [media timeline](#), is greater than or equal to zero.

The [media timeline](#) also has an associated clock. Which clock is used is user-agent defined, and may be [media resource](#)-dependent, but it should approximate the user's wall clock.

[Media elements](#) have a *current playback position*, which must initially (i.e. in the absence of [media data](#)) be zero seconds. The [current playback position](#) is a time on the [media timeline](#).

[Media elements](#) also have an *official playback position*, which must initially be set to zero

seconds. The [official playback position](#) is an approximation of the [current playback position](#) that is kept stable while scripts are running.

[Media elements](#) also have a *default playback start position*, which must initially be set to zero seconds. This time is used to allow the element to be seeked even before the media is loaded.

Each [media element](#) has a *show poster flag*. When a [media element](#) is created, this flag must be set to true. This flag is used to control when the user agent is to show a poster frame for a [video](#) element instead of showing the video contents.

The [currentTime](#) attribute must, on getting, return the [media element's default playback start position](#), unless that is zero, in which case it must return the element's [official playback position](#). The returned value must be expressed in seconds. On setting, if the [media element's readyState](#) is [HAVE NOTHING](#), then it must set the [media element's default playback start position](#) to the new value; otherwise, it must set the [official playback position](#) to the new value and then [seek](#) to the new value. The new value must be interpreted as being in seconds.

If the [media resource](#) is a streaming resource, then the user agent might be unable to obtain certain parts of the resource after it has expired from its buffer. Similarly, some [media resources](#) might have a [media timeline](#) that doesn't start at zero. The *earliest possible position* is the earliest position in the stream or resource that the user agent can ever obtain again. It is also a time on the [media timeline](#).

The [earliest possible position](#) is not explicitly exposed in the API; it corresponds to the start time of the first range in the [seekable](#) attribute's [TimeRanges](#) object, if any, or the [current playback position](#) otherwise.

When the [earliest possible position](#) changes, then: if the [current playback position](#) is before the [earliest possible position](#), the user agent must [seek](#) to the [earliest possible position](#); otherwise, if the user agent has not fired a [timeupdate](#) event at the element in the past 15 to 250ms and is not still running event handlers for such an event, then the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [timeupdate](#) at the element.

Because of the above requirement and the requirement in the [resource fetch algorithm](#) that kicks in [when the metadata of the clip becomes known](#), the [current playback position](#) can never be less than the [earliest possible position](#).

If at any time the user agent learns that an audio or video track has ended and all [media data](#) relating to that track corresponds to parts of the [media timeline](#) that are *before* the [earliest possible position](#), the user agent may [queue a media element task](#) given the [media element](#) to run these steps:

1. Remove the track from the [audioTracks](#) attribute's [AudioTrackList](#) object or the [videoTracks](#) attribute's [VideoTrackList](#) object as appropriate.
2. [Fire an event](#) named [removetrack](#) at the [media element](#)'s aforementioned [AudioTrackList](#) or [VideoTrackList](#) object, using [TrackEvent](#), with the [track](#)

attribute initialized to the [AudioTrack](#) or [VideoTrack](#) object representing the track.

The *duration* attribute must return the time of the end of the [media resource](#), in seconds, on the [media timeline](#). If no [media data](#) is available, then the attributes must return the Not-a-Number (NaN) value. If the [media resource](#) is not known to be bounded (e.g. streaming radio, or a live event with no announced end time), then the attribute must return the positive Infinity value.

The user agent must determine the duration of the [media resource](#) before playing any part of the [media data](#) and before setting [readyState](#) to a value equal to or greater than [HAVE_METADATA](#), even if doing so requires fetching multiple parts of the resource.

When the length of the [media resource](#) changes to a known value (e.g. from being unknown to known, or from a previously established length to a new length) the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [durationchange](#) at the [media element](#). (The event is not fired when the duration is reset as part of loading a new media resource.) If the duration is changed such that the [current playback position](#) ends up being greater than the time of the end of the [media resource](#), then the user agent must also [seek](#) to the time of the end of the [media resource](#).

If an "infinite" stream ends for some reason, then the duration would change from positive Infinity to the time of the last frame or sample in the stream, and the [durationchange](#) event would be fired. Similarly, if the user agent initially estimated the [media resource](#)'s duration instead of determining it precisely, and later revises the estimate based on new information, then the duration would change and the [durationchange](#) event would be fired.

Some video files also have an explicit date and time corresponding to the zero time in the [media timeline](#), known as the *timeline offset*. Initially, the [timeline offset](#) must be set to Not-a-Number (NaN).

The `getStartDate()` method must return [a new Date object](#) representing the current [timeline offset](#).

The *loop* attribute is a [boolean attribute](#) that, if specified, indicates that the [media element](#) is to seek back to the start of the [media resource](#) upon reaching the end.



[HTMLMediaElement/loop](#)

Support in all current engines.

Firefox 11+ | Safari 4+ | Chrome 3+

Opera 12.1+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 9+

Firefox Android14+Safari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

The *loop* IDL attribute must [reflect](#) the content attribute of the same name.

4.8.12.7 Ready states

[media.readyState](#)

✓MDN

[HTMLMediaElement/readyState](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns a value that expresses the current state of the element with respect to rendering the [current playback position](#), from the codes in the list below.

[Media elements](#) have a *ready state*, which describes to what degree they are ready to be rendered at the [current playback position](#). The possible values are as follows; the ready state of a media element at any particular time is the greatest value describing the state of the element:

HAVE NOTHING (numeric value 0)

No information regarding the [media resource](#) is available. No data for the [current playback position](#) is available. [Media elements](#) whose [networkState](#) attribute are set to [NETWORK_EMPTY](#) are always in the [HAVE NOTHING](#) state.

HAVE_METADATA (numeric value 1)

Enough of the resource has been obtained that the duration of the resource is available. In the case of a [video](#) element, the dimensions of the video are also available. No [media data](#) is available for the immediate [current playback position](#).

HAVE_CURRENT_DATA (numeric value 2)

Data for the immediate [current playback position](#) is available, but either not enough data is available that the user agent could successfully advance the [current playback position](#) in the [direction of playback](#) at all without immediately reverting to the [HAVE_METADATA](#) state, or there is no more data to obtain in the [direction of playback](#). For example, in video this corresponds to the user agent having data from the current frame, but not the next

frame, when the [current playback position](#) is at the end of the current frame; and to when [playback has ended](#).

HAVE_FUTURE_DATA (numeric value 3)

Data for the immediate [current playback position](#) is available, as well as enough data for the user agent to advance the [current playback position](#) in the [direction of playback](#) at least a little without immediately reverting to the [HAVE_METADATA](#) state, and [the text tracks are ready](#). For example, in video this corresponds to the user agent having data for at least the current frame and the next frame when the [current playback position](#) is at the instant in time between the two frames, or to the user agent having the video data for the current frame and audio data to keep playing at least a little when the [current playback position](#) is in the middle of a frame. The user agent cannot be in this state if [playback has ended](#), as the [current playback position](#) can never advance in this case.

HAVE_ENOUGH_DATA (numeric value 4)

All the conditions described for the [HAVE_FUTURE_DATA](#) state are met, and, in addition, either of the following conditions is also true:

- The user agent estimates that data is being fetched at a rate where the [current playback position](#), if it were to advance at the element's [playbackRate](#), would not overtake the available data before playback reaches the end of the [media resource](#).
- The user agent has entered a state where waiting longer will not result in further data being obtained, and therefore nothing would be gained by delaying playback any further. (For example, the buffer might be full.)

In practice, the difference between [HAVE_METADATA](#) and [HAVE_CURRENT_DATA](#) is negligible. Really the only time the difference is relevant is when painting a [video](#) element onto a [canvas](#), where it distinguishes the case where something will be drawn ([HAVE_CURRENT_DATA](#) or greater) from the case where nothing is drawn ([HAVE_METADATA](#) or less). Similarly, the difference between [HAVE_CURRENT_DATA](#) (only the current frame) and [HAVE_FUTURE_DATA](#) (at least this frame and the next) can be negligible (in the extreme, only one frame). The only time that distinction really matters is when a page provides an interface for "frame-by-frame" navigation.

When the ready state of a [media element](#) whose [networkState](#) is not [NETWORK_EMPTY](#) changes, the user agent must follow the steps given below:

1. Apply the first applicable set of substeps from the following list:

If the previous ready state was [HAVE NOTHING](#), and the new ready state is [HAVE_METADATA](#)

[Queue a media element task](#) given the [media element](#) to [fire an event](#) named [loadedmetadata](#) at the element.

Before this task is run, as part of the [event loop](#) mechanism, the rendering will have been updated to resize the [video](#) element if appropriate.

If the previous ready state was [**HAVE_METADATA**](#) and the new ready state is [**HAVE_CURRENT_DATA**](#) or greater

If this is the first time this occurs for this [media element](#) since the [load\(\)](#) algorithm was last invoked, the user agent must [queue a media element task](#) given the [media element](#) to [fire an event named `loadeddata`](#) at the element.

If the new ready state is [**HAVE_FUTURE_DATA**](#) or [**HAVE_ENOUGH_DATA**](#), then the relevant steps below must then be run also.

If the previous ready state was [**HAVE_FUTURE_DATA**](#) or more, and the new ready state is [**HAVE_CURRENT_DATA**](#) or less

If the [media element](#) was [potentially playing](#) before its [readyState](#) attribute changed to a value lower than [**HAVE_FUTURE_DATA**](#), and the element has not [ended playback](#), and playback has not [stopped due to errors](#), [paused for user interaction](#), or [paused for in-band content](#), the user agent must [queue a media element task](#) given the [media element](#) to [fire an event named `timeupdate`](#) at the element, and [queue a media element task](#) given the [media element](#) to [fire an event named `waiting`](#) at the element.

If the previous ready state was [**HAVE_CURRENT_DATA**](#) or less, and the new ready state is [**HAVE_FUTURE_DATA**](#)

The user agent must [queue a media element task](#) given the [media element](#) to [fire an event named `canplay`](#) at the element.

If the element's [paused](#) attribute is false, the user agent must [notify about playing](#) for the element.

If the new ready state is [**HAVE_ENOUGH_DATA**](#)

If the previous ready state was [**HAVE_CURRENT_DATA**](#) or less, the user agent must [queue a media element task](#) given the [media element](#) to [fire an event named `canplay`](#) at the element, and, if the element's [paused](#) attribute is false, [notify about playing](#) for the element.

The user agent must [queue a media element task](#) given the [media element](#) to [fire an event named `canplaythrough`](#) at the element.

If the element is not [eligible for autoplay](#), then the user agent must abort these substeps.

The user agent may run the following substeps:

1. Set the [paused](#) attribute to false.
2. If the element's [show poster flag](#) is true, set it to false and run the [time marches on](#) steps.
3. [Queue a media element task](#) given the element to [fire an event](#) named [play](#) at the element.
4. [Notify about playing](#) for the element.

Alternatively, if the element is a [video](#) element, the user agent may start observing whether the element [intersects the viewport](#). When the element starts [intersecting the viewport](#), if the element is still [eligible for autoplay](#), run the substeps above. Optionally, when the element stops [intersecting the viewport](#), if the [can autoplay flag](#) is still true and the [autoplay](#) attribute is still specified, run the following substeps:

1. Run the [internal pause steps](#) and set the [can autoplay flag](#) to true.
2. [Queue a media element task](#) given the element to [fire an event](#) named [pause](#) at the element.

The substeps for playing and pausing can run multiple times as the element starts or stops [intersecting the viewport](#), as long as the [can autoplay flag](#) is true.

User agents do not need to support autoplay, and it is suggested that user agents honor user preferences on the matter. Authors are urged to use the [autoplay](#) attribute rather than using script to force the video to play, so as to allow the user to override the behavior if so desired.

It is possible for the ready state of a media element to jump between these states discontinuously. For example, the state of a media element can jump straight from [HAVE_METADATA](#) to [HAVE_ENOUGH_DATA](#) without passing through the [HAVE_CURRENT_DATA](#) and [HAVE_FUTURE_DATA](#) states.

The `readyState` IDL attribute must, on getting, return the value described above that describes the current ready state of the [media element](#).

The [autoplay](#) attribute is a [boolean attribute](#). When present, the user agent (as described in the algorithm described herein) will automatically begin playback of the [media resource](#) as soon as it can do so without stopping.

Authors are urged to use the [autoplay](#) attribute rather than using script to trigger automatic playback, as this allows the user to override the automatic playback when it is not desired, e.g. when using a screen reader. Authors are also encouraged to consider not using the automatic playback behavior at all, and instead to let the user agent wait for the user to start playback explicitly.



Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

The `autoplay` IDL attribute must [reflect](#) the content attribute of the same name.

4.8.12.8 Playing the media resource

`media.paused`



[HTMLMediaElement/paused](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns true if playback is paused; false otherwise.

`media.ended`



[HTMLMediaElement/ended](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns true if playback has reached the end of the [media resource](#).

`media.defaultPlaybackRate [= value]`



[HTMLMediaElement/defaultPlaybackRate](#)

Support in all current engines.

Firefox 20+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 20+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the default rate of playback, for when the user is not fast-forwarding or reversing through the [media resource](#).

Can be set, to change the default rate of playback.

The default rate has no direct effect on playback, but if the user switches to a fast-forward mode, when they return to the normal playback mode, it is expected that the rate of playback will be returned to the default rate of playback.

[media.playbackRate \[= value \]](#)

✓MDN

[HTMLMediaElement/playbackRate](#)

Support in all current engines.

Firefox 20+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 20+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the current rate playback, where 1.0 is normal speed.

Can be set, to change the rate of playback.

[media.preservesPitch](#)

Returns true if pitch-preserving algorithms are used when the [playbackRate](#) is not 1.0. The default value is true.

Can be set to false to have the [media resource](#)'s audio pitch change up or down depending on the [playbackRate](#). This is useful for aesthetic and performance reasons.

[media.played](#)

Returns a [TimeRanges](#) object that represents the ranges of the [media resource](#) that the

user agent has played.

[`media.play\(\)`](#)

✓MDN

[HTMLMediaElement/play](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 10.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

Sets the [paused](#) attribute to false, loading the [media resource](#) and beginning playback if necessary. If the playback had ended, will restart it from the start.

[`media.pause\(\)`](#)

✓MDN

[HTMLMediaElement/pause](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Sets the [paused](#) attribute to true, loading the [media resource](#) if necessary.

The [paused](#) attribute represents whether the [media element](#) is paused or not. The attribute must initially be true.

A [media element](#) is a *blocked media element* if its [readyState](#) attribute is in the [HAVE NOTHING](#) state, the [HAVE_METADATA](#) state, or the [HAVE_CURRENT_DATA](#) state, or if the element has [paused for user interaction](#) or [paused for in-band content](#).

A [media element](#) is said to be *potentially playing* when its [paused](#) attribute is false, the element has not [ended playback](#), playback has not [stopped due to errors](#), and the element is not a [blocked media element](#).

A [waiting](#) DOM event [can be fired](#) as a result of an element that is [potentially playing](#) stopping playback due to its [readyState](#) attribute changing to a value lower than

HAVE_FUTURE_DATA.

A [media element](#) is said to be *eligible for autoplay* when all of the following conditions are met:

- Its [can autoplay flag](#) is true.
- Its [paused](#) attribute is true.
- It has an [autoplay](#) attribute specified.
- Its [node document's active sandboxing flag set](#) does not have the [sandboxed automatic features browsing context flag set](#).
- Its [node document](#) is [allowed to use](#) the "[autoplay](#)" feature.

A [media element](#) is said to be *allowed to play* if the user agent and the system allow media playback in the current context.

For example, a user agent could allow playback only when the [media element's Window object](#) has [transient activation](#), but an exception could be made to allow playback while [muted](#).

A [media element](#) is said to have *ended playback* when:

- The element's [readyState](#) attribute is [HAVE_METADATA](#) or greater, and
- Either:
 - The [current playback position](#) is the end of the [media resource](#), and
 - The [direction of playback](#) is forwards, and
 - The [media element](#) does not have a [loop](#) attribute specified.

Or:

- The [current playback position](#) is the [earliest possible position](#), and
- The [direction of playback](#) is backwards.

The [ended](#) attribute must return true if, the last time the [event loop](#) reached [step 1](#), the [media element](#) had [ended playback](#) and the [direction of playback](#) was forwards, and false otherwise.

A [media element](#) is said to have *stopped due to errors* when the element's [readyState](#) attribute is [HAVE_METADATA](#) or greater, and the user agent [encounters a non-fatal error](#) during the processing of the [media data](#), and due to that error, is not able to play the content at the [current playback position](#).

A [media element](#) is said to have *paused for user interaction* when its [paused](#) attribute is false, the [readyState](#) attribute is either [HAVE_FUTURE_DATA](#) or [HAVE_ENOUGH_DATA](#) and the user agent has reached a point in the [media resource](#) where the user has to make a selection for the resource to continue.

It is possible for a [media element](#) to have both [ended playback](#) and [paused for user interaction](#) at the same time.

When a [media element](#) that is [potentially playing](#) stops playing because it has [paused for user interaction](#), the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [timeupdate](#) at the element.

A [media element](#) is said to have *paused for in-band content* when its [paused](#) attribute is false, the [readyState](#) attribute is either [HAVE_FUTURE_DATA](#) or [HAVE_ENOUGH_DATA](#) and the user agent has suspended playback of the [media resource](#) in order to play content that is temporally anchored to the [media resource](#) and has a nonzero length, or to play content that is temporally anchored to a segment of the [media resource](#) but has a length longer than that segment.

One example of when a [media element](#) would be [paused for in-band content](#) is when the user agent is playing [audio descriptions](#) from an external WebVTT file, and the synthesized speech generated for a cue is longer than the time between the [text track cue start time](#) and the [text track cue end time](#).

When the [current playback position](#) reaches the end of the [media resource](#) when the [direction of playback](#) is forwards, then the user agent must follow these steps:

1. If the [media element](#) has a [loop](#) attribute specified, then [seek](#) to the [earliest possible position](#) of the [media resource](#) and return.
2. As defined above, the [ended](#) IDL attribute starts returning true once the [event loop](#) returns to [step 1](#).
3. [Queue a media element task](#) given the [media element](#) and the following steps:
 1. [Fire an event](#) named [timeupdate](#) at the [media element](#).
 2. If the [media element](#) has [ended playback](#), the [direction of playback](#) is forwards, and [paused](#) is false, then:
 1. Set the [paused](#) attribute to true.
 2. [Fire an event](#) named [pause](#) at the [media element](#).
 3. [Take pending play promises](#) and [reject pending play promises](#) with the result and an ["AbortError" DOMException](#).
 3. [Fire an event](#) named [ended](#) at the [media element](#).

When the [current playback position](#) reaches the [earliest possible position](#) of the [media resource](#) when the [direction of playback](#) is backwards, then the user agent must only [queue a media element task](#) given the [media element](#) to [fire an event](#) named [timeupdate](#) at the element.

The word "reaches" here does not imply that the [current playback position](#) needs to have

changed during normal playback; it could be via [seeking](#), for instance.

The **defaultPlaybackRate** attribute gives the desired speed at which the [media resource](#) is to play, as a multiple of its intrinsic speed. The attribute is mutable: on getting it must return the last value it was set to, or 1.0 if it hasn't yet been set; on setting the attribute must be set to the new value.

The **defaultPlaybackRate** is used by the user agent when it [exposes a user interface to the user](#).

The **playbackRate** attribute gives the effective playback rate, which is the speed at which the [media resource](#) plays, as a multiple of its intrinsic speed. If it is not equal to the [defaultPlaybackRate](#), then the implication is that the user is using a feature such as fast forward or slow motion playback. The attribute is mutable: on getting it must return the last value it was set to, or 1.0 if it hasn't yet been set; on setting, the user agent must follow these steps:

1. If the given value is not supported by the user agent, then throw a ["NotSupportedError" DOMException](#).
2. Set [playbackRate](#) to the new value, and if the element is [potentially playing](#), change the playback speed.

When the [defaultPlaybackRate](#) or [playbackRate](#) attributes change value (either by being set by script or by being changed directly by the user agent, e.g. in response to user control) the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [ratechange](#) at the [media element](#). The user agent must process attribute changes smoothly and must not introduce any perceivable gaps or muting of playback in response.

The **preservesPitch** getter steps are to return true if a pitch-preserving algorithm is in effect during playback. The setter steps are to correspondingly switch the pitch-preserving algorithm on or off, without any perceivable gaps or muting of playback. By default, such a pitch-preserving algorithm must be in effect (i.e., the getter will initially return true).

The **played** attribute must return a new static [normalized TimeRanges object](#) that represents the ranges of points on the [media timeline](#) of the [media resource](#) reached through the usual monotonic increase of the [current playback position](#) during normal playback, if any, at the time the attribute is evaluated.

Returning a new object each time is a bad pattern for attribute getters and is only enshrined here as it would be costly to change it. It is not to be copied to new APIs.

Each [media element](#) has a *list of pending play promises*, which must initially be empty.

To take pending play promises for a [media element](#), the user agent must run the following steps:

1. Let *promises* be an empty list of promises.
2. Copy the [media element](#)'s [list of pending play promises](#) to *promises*.
3. Clear the [media element](#)'s [list of pending play promises](#).
4. Return *promises*.

To resolve pending play promises for a [media element](#) with a list of promises *promises*, the user agent must resolve each promise in *promises* with undefined.

To reject pending play promises for a [media element](#) with a list of promise *promises* and an exception name *error*, the user agent must reject each promise in *promises* with *error*.

To notify about playing for a [media element](#), the user agent must run the following steps:

1. [Take pending play promises](#) and let *promises* be the result.
2. [Queue a media element task](#) given the element and the following steps:
 1. [Fire an event](#) named [playing](#) at the element.
 2. [Resolve pending play promises](#) with *promises*.

When the [play\(\)](#) method on a [media element](#) is invoked, the user agent must run the following steps.

1. If the [media element](#) is not [allowed to play](#), return a promise rejected with a ["NotAllowedError" DOMException](#).
2. If the [media element](#)'s [error](#) attribute is not null and its [code](#) is [MEDIA_ERR_SRC_NOT_SUPPORTED](#), return a promise rejected with a ["NotSupportedError" DOMException](#).

This means that the [dedicated media source failure steps](#) have run. Playback is not possible until the [media element load algorithm](#) clears the [error](#) attribute.

3. Let *promise* be a new promise and append *promise* to the [list of pending play promises](#).
4. Run the [internal play steps](#) for the [media element](#).
5. Return *promise*.

The [internal play steps](#) for a [media element](#) are as follows:

1. If the [media element](#)'s [networkState](#) attribute has the value [NETWORK_EMPTY](#), invoke the [media element's resource selection algorithm](#).
2. If the [playback has ended](#) and the [direction of playback](#) is forwards, [seek](#) to the [earliest possible position](#) of the [media resource](#).

This [will cause](#) the user agent to [queue a media element task](#) given the [media element](#) to [fire an event](#) named [timeupdate](#) at the [media element](#).

3. If the [media element](#)'s [paused](#) attribute is true, then:
 1. Change the value of [paused](#) to false.
 2. If the [show poster flag](#) is true, set the element's [show poster flag](#) to false and run the [time marches on](#) steps.
 3. [Queue a media element task](#) given the [media element](#) to [fire an event](#) named [play](#) at the element.
 4. If the [media element](#)'s [readyState](#) attribute has the value [HAVE NOTHING](#), [HAVE_METADATA](#), or [HAVE_CURRENT_DATA](#), [queue a media element task](#) given the [media element](#) to [fire an event](#) named [waiting](#) at the element.

Otherwise, the [media element](#)'s [readyState](#) attribute has the value [HAVE_FUTURE_DATA](#) or [HAVE_ENOUGH_DATA](#): [notify about playing](#) for the element.

4. Otherwise, if the [media element](#)'s [readyState](#) attribute has the value [HAVE_FUTURE_DATA](#) or [HAVE_ENOUGH_DATA](#), [take pending play promises](#) and [queue a media element task](#) given the [media element](#) to [resolve pending play promises](#) with the result.

The media element is already playing. However, it's possible that [promise](#) will be [rejected](#) before the queued task is run.

5. Set the [media element](#)'s [can autoplay flag](#) to false.

When the [pause\(\)](#) method is invoked, and when the user agent is required to pause the [media element](#), the user agent must run the following steps:

1. If the [media element](#)'s [networkState](#) attribute has the value [NETWORK_EMPTY](#), invoke the [media element's resource selection algorithm](#).
2. Run the [internal pause steps](#) for the [media element](#).

The [internal pause steps](#) for a [media element](#) are as follows:

1. Set the [media element](#)'s [can autoplay flag](#) to false.
 2. If the [media element](#)'s [paused](#) attribute is false, run the following steps:
 1. Change the value of [paused](#) to true.
 2. [Take pending play promises](#) and let *promises* be the result.
 3. [Queue a media element task](#) given the [media element](#) and the following steps:
 1. [Fire an event](#) named [timeupdate](#) at the element.
 2. [Fire an event](#) named [pause](#) at the element.
 3. [Reject pending play promises](#) with *promises* and an [AbortError](#) [DOMException](#).
 4. Set the [official playback position](#) to the [current playback position](#).
-

If the element's [playbackRate](#) is positive or zero, then the *direction of playback* is forwards. Otherwise, it is backwards.

When a [media element](#) is [potentially playing](#) and its [Document](#) is a [fully active Document](#), its [current playback position](#) must increase monotonically at the element's [playbackRate](#) units of media time per unit time of the [media timeline](#)'s clock. (This specification always refers to this as an *increase*, but that increase could actually be a *decrease* if the element's [playbackRate](#) is negative.)

The element's [playbackRate](#) can be 0.0, in which case the [current playback position](#) doesn't move, despite playback not being paused ([paused](#) doesn't become true, and the [pause](#) event doesn't fire).

This specification doesn't define how the user agent achieves the appropriate playback rate — depending on the protocol and media available, it is plausible that the user agent could negotiate with the server to have the server provide the media data at the appropriate rate, so that (except for the period between when the rate is changed and when the server updates the stream's playback rate) the client doesn't actually have to drop or interpolate any frames.

Any time the user agent [provides a stable state](#), the [official playback position](#) must be set to the [current playback position](#).

While the [direction of playback](#) is backwards, any corresponding audio must be [muted](#). While the element's [playbackRate](#) is so low or so high that the user agent cannot play audio usefully, the corresponding audio must also be [muted](#). If the element's [playbackRate](#) is not 1.0 and [preservesPitch](#) is true, the user agent must apply pitch adjustment to preserve the original pitch of the audio. Otherwise, the user agent must speed up or slow down the audio

without any pitch adjustment.

When a [media element](#) is [potentially playing](#), its audio data played must be synchronized with the [current playback position](#), at the element's [effective media volume](#). The user agent must play the audio from audio tracks that were enabled when the [event loop](#) last reached [step 1](#).

When a [media element](#) is not [potentially playing](#), audio must not play for the element.

[Media elements](#) that are [potentially playing](#) while not [in a document](#) must not play any video, but should play any audio component. Media elements must not stop playing just because all references to them have been removed; only once a media element is in a state where no further audio could ever be played by that element may the element be garbage collected.

It is possible for an element to which no explicit references exist to play audio, even if such an element is not still actively playing: for instance, it could be unpause but stalled waiting for content to buffer, or it could be still buffering, but with a [suspend](#) event listener that begins playback. Even a media element whose [media resource](#) has no audio tracks could eventually play audio again if it had an event listener that changes the [media resource](#).

Each [media element](#) has a *list of newly introduced cues*, which must be initially empty. Whenever a [text track cue](#) is added to the [list of cues](#) of a [text track](#) that is in the [list of text tracks](#) for a [media element](#), that [cue](#) must be added to the [media element's list of newly introduced cues](#). Whenever a [text track](#) is added to the [list of text tracks](#) for a [media element](#), all of the [cues](#) in that [text track's list of cues](#) must be added to the [media element's list of newly introduced cues](#). When a [media element's list of newly introduced cues](#) has new cues added while the [media element's show poster flag](#) is not set, then the user agent must run the [time marches on](#) steps.

When a [text track cue](#) is removed from the [list of cues](#) of a [text track](#) that is in the [list of text tracks](#) for a [media element](#), and whenever a [text track](#) is removed from the [list of text tracks](#) of a [media element](#), if the [media element's show poster flag](#) is not set, then the user agent must run the [time marches on](#) steps.

When the [current playback position](#) of a [media element](#) changes (e.g. due to playback or seeking), the user agent must run the [time marches on](#) steps. To support use cases that depend on the timing accuracy of cue event firing, such as synchronizing captions with shot changes in a video, user agents should fire cue events as close as possible to their position on the media timeline, and ideally within 20 milliseconds. If the [current playback position](#) changes while the steps are running, then the user agent must wait for the steps to complete, and then must immediately rerun the steps. These steps are thus run as often as possible or needed.

If one iteration takes a long time, this can cause short duration [cues](#) to be skipped over as the user agent rushes ahead to "catch up", so these cues will not appear in the [activeCues](#) list.

The *time marches on* steps are as follows:

1. Let *current cues* be a list of [cues](#), initialized to contain all the [cues](#) of all the [hidden](#) or

[showing text tracks](#) of the [media element](#) (not the [disabled](#) ones) whose [start times](#) are less than or equal to the [current playback position](#) and whose [end times](#) are greater than the [current playback position](#).

2. Let *other cues* be a list of [cues](#), initialized to contain all the [cues](#) of [hidden](#) and [showing text tracks](#) of the [media element](#) that are not present in *current cues*.
3. Let *last time* be the [current playback position](#) at the time this algorithm was last run for this [media element](#), if this is not the first time it has run.
4. If the [current playback position](#) has, since the last time this algorithm was run, only changed through its usual monotonic increase during normal playback, then let *missed cues* be the list of [cues](#) in *other cues* whose [start times](#) are greater than or equal to *last time* and whose [end times](#) are less than or equal to the [current playback position](#). Otherwise, let *missed cues* be an empty list.
5. Remove all the [cues](#) in *missed cues* that are also in the [media element's list of newly introduced cues](#), and then empty the element's [list of newly introduced cues](#).
6. If the time was reached through the usual monotonic increase of the [current playback position](#) during normal playback, and if the user agent has not fired a [timeupdate](#) event at the element in the past 15 to 250ms and is not still running event handlers for such an event, then the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [timeupdate](#) at the element. (In the other cases, such as explicit seeks, relevant events get fired as part of the overall process of changing the [current playback position](#).)

The event thus is not to be fired faster than about 66Hz or slower than 4Hz (assuming the event handlers don't take longer than 250ms to run). User agents are encouraged to vary the frequency of the event based on the system load and the average cost of processing the event each time, so that the UI updates are not any more frequent than the user agent can comfortably handle while decoding the video.

7. If all of the [cues](#) in *current cues* have their [text track cue active flag](#) set, none of the [cues](#) in *other cues* have their [text track cue active flag](#) set, and *missed cues* is empty, then return.
8. If the time was reached through the usual monotonic increase of the [current playback position](#) during normal playback, and there are [cues](#) in *other cues* that have their [text track cue pause-on-exit flag](#) set and that either have their [text track cue active flag](#) set or are also in *missed cues*, then [immediately pause](#) the [media element](#).

In the other cases, such as explicit seeks, playback is not paused by going past the end time of a [cue](#), even if that [cue](#) has its [text track cue pause-on-exit flag](#) set.

9. Let *events* be a list of [tasks](#), initially empty. Each [task](#) in this list will be associated with a [text track](#), a [text track cue](#), and a time, which are used to sort the list before the [tasks](#) are queued.

Let *affected tracks* be a list of [text tracks](#), initially empty.

When the steps below say to *prepare an event* named *event* for a [text track cue](#) *target* with a time *time*, the user agent must run these steps:

1. Let *track* be the [text track](#) with which the [text track cue](#) *target* is associated.
 2. Create a [task](#) to [fire an event](#) named *event* at *target*.
 3. Add the newly created [task](#) to *events*, associated with the time *time*, the [text track](#) *track*, and the [text track cue](#) *target*.
 4. Add *track* to *affected tracks*.
10. For each [text track cue](#) in *missed cues*, [prepare an event](#) named [enter](#) for the [TextTrackCue](#) object with the [text track cue start time](#).
 11. For each [text track cue](#) in *other cues* that either has its [text track cue active flag](#) set or is in *missed cues*, [prepare an event](#) named [exit](#) for the [TextTrackCue](#) object with the later of the [text track cue end time](#) and the [text track cue start time](#).
 12. For each [text track cue](#) in *current cues* that does not have its [text track cue active flag](#) set, [prepare an event](#) named [enter](#) for the [TextTrackCue](#) object with the [text track cue start time](#).
 13. Sort the [tasks](#) in *events* in ascending time order ([tasks](#) with earlier times first).
Further sort [tasks](#) in *events* that have the same time by the relative [text track cue order](#) of the [text track cues](#) associated with these [tasks](#).
Finally, sort [tasks](#) in *events* that have the same time and same [text track cue order](#) by placing [tasks](#) that fire [enter](#) events before those that fire [exit](#) events.

14. [Queue a media element task](#) given the [media element](#) for each [task](#) in *events*, in list order.
15. Sort *affected tracks* in the same order as the [text tracks](#) appear in the [media element's list of text tracks](#), and remove duplicates.
16. For each [text track](#) in *affected tracks*, in the list order, [queue a media element task](#) given the [media element](#) to [fire an event](#) named [cuechange](#) at the [TextTrack](#) object, and, if the [text track](#) has a corresponding [track](#) element, to then [fire an event](#) named [cuechange](#) at the [track](#) element as well.
17. Set the [text track cue active flag](#) of all the [cues](#) in the *current cues*, and unset the [text track cue active flag](#) of all the [cues](#) in the *other cues*.
18. Run the [rules for updating the text track rendering](#) of each of the [text tracks](#) in *affected*

tracks that are [showing](#), providing the [text track](#)'s [text track language](#) as the fallback language if it is not the empty string. For example, for [text tracks](#) based on WebVTT, the [rules for updating the display of WebVTT text tracks](#). [WEBVTT]

For the purposes of the algorithm above, a [text track cue](#) is considered to be part of a [text track](#) only if it is listed in the [text track list of cues](#), not merely if it is associated with the [text track](#).

If the [media element](#)'s [node document](#) stops being a [fully active](#) document, then the playback will [stop](#) until the document is active again.

When a [media element](#) is [removed from a Document](#), the user agent must run the following steps:

1. [Await a stable state](#), allowing the [task](#) that removed the [media element](#) from the [Document](#) to continue. The [synchronous section](#) consists of all the remaining steps of this algorithm. (Steps in the [synchronous section](#) are marked with \mathbb{X} .)
2. \mathbb{X} If the [media element](#) is [in a document](#), return.
3. \mathbb{X} Run the [internal pause steps](#) for the [media element](#).

4.8.12.9 Seeking

[media.seeking](#)

Returns true if the user agent is currently seeking.

[media.seekable](#)



[HTMLMediaElement/seekable](#)

Support in all current engines.

Firefox 8+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 8+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns a [TimeRanges](#) object that represents the ranges of the [media resource](#) to which it is possible for the user agent to seek.

[media.fastSeek\(time\)](#)



[HTMLMediaElement/fastSeek](#)

Firefox 31+ Safari 8+ Chrome No

Opera No Edge No

Edge (Legacy) No Internet Explorer No

Firefox Android 31+ Safari iOS 8+ Chrome Android No WebView Android No Samsung

Internet No Opera Android No

Seeks to near the given *time* as fast as possible, trading precision for speed. (To seek to a precise time, use the [currentTime](#) attribute.)

This does nothing if the media resource has not been loaded.

The *seeking* attribute must initially have the value false.

The *fastSeek(time)* method must [seek](#) to the time given by *time*, with the *approximate-for-speed* flag set.

When the user agent is required to seek to a particular *new playback position* in the [media resource](#), optionally with the *approximate-for-speed* flag set, it means that the user agent must run the following steps. This algorithm interacts closely with the [event loop](#) mechanism; in particular, it has a [synchronous section](#) (which is triggered as part of the [event loop](#) algorithm). Steps in that section are marked with ☒.

1. Set the [media element](#)'s [show poster flag](#) to false.
2. If the [media element](#)'s [readyState](#) is [HAVE NOTHING](#), return.
3. If the element's [seeking](#) IDL attribute is true, then another instance of this algorithm is already running. Abort that other instance of the algorithm without waiting for the step that it is running to complete.
4. Set the [seeking](#) IDL attribute to true.
5. If the seek was in response to a DOM method call or setting of an IDL attribute, then continue the script. The remainder of these steps must be run [in parallel](#). With the exception of the steps marked with ☒, they could be aborted at any time by another instance of this algorithm being invoked.
6. If the *new playback position* is later than the end of the [media resource](#), then let it be the end of the [media resource](#) instead.
7. If the *new playback position* is less than the [earliest possible position](#), let it be that position instead.
8. If the (possibly now changed) *new playback position* is not in one of the ranges given in the [seekable](#) attribute, then let it be the position in one of the ranges given in the

[seekable](#) attribute that is the nearest to the *new playback position*. If two positions both satisfy that constraint (i.e. the *new playback position* is exactly in the middle between two ranges in the [seekable](#) attribute) then use the position that is closest to the [current playback position](#). If there are no ranges given in the [seekable](#) attribute then set the [seeking](#) IDL attribute to false and return.

9. If the *approximate-for-speed* flag is set, adjust the *new playback position* to a value that will allow for playback to resume promptly. If *new playback position* before this step is before [current playback position](#), then the adjusted *new playback position* must also be before the [current playback position](#). Similarly, if the *new playback position* before this step is after [current playback position](#), then the adjusted *new playback position* must also be after the [current playback position](#).

For example, the user agent could snap to a nearby key frame, so that it doesn't have to spend time decoding then discarding intermediate frames before resuming playback.

10. [Queue a media element task](#) given the [media element](#) to [fire an event](#) named [seeking](#) at the element.
11. Set the [current playback position](#) to the *new playback position*.

If the [media element](#) was [potentially playing](#) immediately before it started seeking, but seeking caused its [readyState](#) attribute to change to a value lower than [HAVE_FUTURE_DATA](#), then a [waiting](#) event [will be fired](#) at the element.

This step sets the [current playback position](#), and thus can immediately trigger other conditions, such as the rules regarding when playback "[reaches the end of the media resource](#)" (part of the logic that handles looping), even before the user agent is actually able to render the media data for that position (as determined in the next step).

The [currentTime](#) attribute returns the [official playback position](#), not the [current playback position](#), and therefore gets updated before script execution, separate from this algorithm.

12. Wait until the user agent has established whether or not the [media data](#) for the *new playback position* is available, and, if it is, until it has decoded enough data to play back that position.
13. [Await a stable state](#). The [synchronous section](#) consists of all the remaining steps of this algorithm. (Steps in the [synchronous section](#) are marked with ☒.)
 14. ☒ Set the [seeking](#) IDL attribute to false.
 15. ☒ Run the [time marches on](#) steps.
 16. ☒ [Queue a media element task](#) given the [media element](#) to [fire an event](#) named [timeupdate](#) at the element.

-
17. ☐ Queue a media element task given the [media element](#) to [fire an event](#) named [seeked](#) at the element.

The `seekable` attribute must return a new static [normalized TimeRanges object](#) that represents the ranges of the [media resource](#), if any, that the user agent is able to seek to, at the time the attribute is evaluated.

If the user agent can seek to anywhere in the [media resource](#), e.g. because it is a simple movie file and the user agent and the server support HTTP Range requests, then the attribute would return an object with one range, whose start is the time of the first frame (the [earliest possible position](#), typically zero), and whose end is the same as the time of the first frame plus the [duration](#) attribute's value (which would equal the time of the last frame, and might be positive Infinity).

The range might be continuously changing, e.g. if the user agent is buffering a sliding window on an infinite stream. This is the behavior seen with DVRs viewing live TV, for instance.

Returning a new object each time is a bad pattern for attribute getters and is only enshrined here as it would be costly to change it. It is not to be copied to new APIs.

User agents should adopt a very liberal and optimistic view of what is seekable. User agents should also buffer recent content where possible to enable seeking to be fast.

For instance, consider a large video file served on an HTTP server without support for HTTP Range requests. A browser *could* implement this by only buffering the current frame and data obtained for subsequent frames, never allow seeking, except for seeking to the very start by restarting the playback. However, this would be a poor implementation. A high quality implementation would buffer the last few minutes of content (or more, if sufficient storage space is available), allowing the user to jump back and rewatch something surprising without any latency, and would in addition allow arbitrary seeking by reloading the file from the start if necessary, which would be slower but still more convenient than having to literally restart the video and watch it all the way through just to get to an earlier unbuffered spot.

[Media resources](#) might be internally scripted or interactive. Thus, a [media element](#) could play in a non-linear fashion. If this happens, the user agent must act as if the algorithm for [seeking](#) was used whenever the [current playback position](#) changes in a discontinuous fashion (so that the relevant events fire).

4.8.12.10 Media resources with multiple media tracks

A [media resource](#) can have multiple embedded audio and video tracks. For example, in addition to the primary video and audio tracks, a [media resource](#) could have foreign-language dubbed dialogues, director's commentaries, audio descriptions, alternative angles, or sign-language overlays.

[media.audioTracks](#)



[HTMLMediaElement/audioTracks](#)

Support in all current engines.

Firefox 33+ Safari 8+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 8+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

Returns an [AudioTrackList](#) object representing the audio tracks available in the [media resource](#).

[media.videoTracks](#)



[HTMLMediaElement/videoTracks](#)

Support in all current engines.

Firefox 33+ Safari 8+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 33+ Safari iOS 8+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

Returns a [VideoTrackList](#) object representing the video tracks available in the [media resource](#).

The **audioTracks** attribute of a [media element](#) must return a [live AudioTrackList](#) object representing the audio tracks available in the [media element's media resource](#).

The **videoTracks** attribute of a [media element](#) must return a [live VideoTrackList](#) object representing the video tracks available in the [media element's media resource](#).

There are only ever one [AudioTrackList](#) object and one [VideoTrackList](#) object per [media element](#), even if another [media resource](#) is loaded into the element: the objects are reused. (The [AudioTrack](#) and [VideoTrack](#) objects are not, though.)

4.8.12.10.1 [AudioTrackList](#) and [VideoTrackList](#) objects



[AudioTrackList](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

[VideoTrackList](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

[AudioTrack](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

[caniuse.com table](#)

The [AudioTrackList](#) and [VideoTrackList](#) interfaces are used by attributes defined in the previous section.



[AudioTrack](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

[VideoTrack](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

[Exposed=Window]

```
interface AudioTrackList : EventTarget {  
    readonly attribute unsigned long length;  
    getter AudioTrack (unsigned long index);  
    AudioTrack? getTrackById(DOMString id);  
  
    attribute EventHandler onchange;  
    attribute EventHandler onaddtrack;  
    attribute EventHandler onremovetrack;  
};
```

[Exposed=Window]

```
interface AudioTrack {  
    readonly attribute DOMString id;  
    readonly attribute DOMString kind;  
    readonly attribute DOMString label;  
    readonly attribute DOMString language;  
    attribute boolean enabled;  
};
```

[Exposed=Window]

```
interface VideoTrackList : EventTarget {  
    readonly attribute unsigned long length;  
    getter VideoTrack (unsigned long index);  
    VideoTrack? getTrackById(DOMString id);  
    readonly attribute long selectedIndex;  
  
    attribute EventHandler onchange;  
    attribute EventHandler onaddtrack;  
    attribute EventHandler onremovetrack;  
};
```

[Exposed=Window]

```
interface VideoTrack {  
    readonly attribute DOMString id;  
    readonly attribute DOMString kind;  
    readonly attribute DOMString label;
```

```
readonly attribute DOMString language;  
attribute boolean selected;  
};
```

[media.audioTracks.length](#)

✓MDN

[AudioTrackList/length](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

[media.videoTracks.length](#)

✓MDN

[VideoTrackList/length](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

Returns the number of tracks in the list.

`audioTrack = media.audioTracks[index]`
`videoTrack = media.videoTracks[index]`

Returns the specified [AudioTrack](#) or [VideoTrack](#) object.

`audioTrack = media.audioTracks.getTrackById(id)`

✓MDN

[AudioTrackList/getTrackById](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS7+Chrome Android 37+WebView AndroidNoSamsung

InternetNoOpera Android 24+

`videoTrack = media.videoTracks.getTrackById(id)`

✓MDN

[VideoTrackList/getTrackById](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS7+Chrome Android 37+WebView AndroidNoSamsung

InternetNoOpera Android 24+

Returns the [AudioTrack](#) or [VideoTrack](#) object with the given identifier, or null if no track has that identifier.

`audioTrack.id`

✓MDN

[AudioTrack/id](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS7+Chrome Android 37+WebView AndroidNoSamsung

InternetNoOpera Android 24+

`videoTrack.id`

✓MDN

[VideoTrack/id](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS7+Chrome Android 37+WebView AndroidNoSamsung

InternetNoOpera Android 24+

Returns the ID of the given track. This is the ID that can be used with a [fragment](#) if the

format supports [media fragment syntax](#), and that can be used with the `getTrackById()` method.

`audioTrack.kind`



[AudioTrack/kind](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

`videoTrack.kind`



[VideoTrack/kind](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

Returns the category the given track falls into. The [possible track categories](#) are given below.

`audioTrack.label`



[AudioTrack/label](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

`videoTrack.label`



[VideoTrack/label](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

Returns the label of the given track, if known, or the empty string otherwise.

[audioTrack.language](#)

✓MDN

[AudioTrack/language](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

[videoTrack.language](#)

✓MDN

[VideoTrack/language](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+

Returns the language of the given track, if known, or the empty string otherwise.

[audioTrack.enabled \[= value \]](#)

✓MDN

[AudioTrack/enabled](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer 10+

Firefox Android 33+Safari iOS 7+Chrome Android 37+WebView Android NoSamsung Internet NoOpera Android 24+

Returns true if the given track is active, and false otherwise.

Can be set, to change whether the track is enabled or not. If multiple audio tracks are enabled simultaneously, they are mixed.

media.videoTracks.selectedIndex

✓MDN

[VideoTrackList/selectedIndex](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer 10+

Firefox Android 33+Safari iOS 7+Chrome Android 37+WebView Android NoSamsung Internet NoOpera Android 24+

Returns the index of the currently selected track, if any, or -1 otherwise.

videoTrack.selected [= value]

✓MDN

[VideoTrack/selected](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer 10+

Firefox Android 33+Safari iOS 7+Chrome Android 37+WebView Android NoSamsung Internet NoOpera Android 24+

Returns true if the given track is active, and false otherwise.

Can be set, to change whether the track is selected or not. Either zero or one video track is selected; selecting a new track while a previous one is selected will unselect the previous one.

An [AudioTrackList](#) object represents a dynamic list of zero or more audio tracks, of which

zero or more can be enabled at a time. Each audio track is represented by an [AudioTrack](#) object.

A [VideoTrackList](#) object represents a dynamic list of zero or more video tracks, of which zero or one can be selected at a time. Each video track is represented by a [VideoTrack](#) object.

Tracks in [AudioTrackList](#) and [VideoTrackList](#) objects must be consistently ordered. If the [media resource](#) is in a format that defines an order, then that order must be used; otherwise, the order must be the relative order in which the tracks are declared in the [media resource](#). The order used is called the *natural order* of the list.

Each track in one of these objects thus has an index; the first has the index 0, and each subsequent track is numbered one higher than the previous one. If a [media resource](#) dynamically adds or removes audio or video tracks, then the indices of the tracks will change dynamically. If the [media resource](#) changes entirely, then all the previous tracks will be removed and replaced with new tracks.

The [AudioTrackList length](#) and [VideoTrackList length](#) attribute getters must return the number of tracks represented by their objects at the time of getting.

The [supported property indices](#) of [AudioTrackList](#) and [VideoTrackList](#) objects at any instant are the numbers from zero to the number of tracks represented by the respective object minus one, if any tracks are represented. If an [AudioTrackList](#) or [VideoTrackList](#) object represents no tracks, it has no [supported property indices](#).

To [determine the value of an indexed property](#) for a given index *index* in an [AudioTrackList](#) or [VideoTrackList](#) object *list*, the user agent must return the [AudioTrack](#) or [VideoTrack](#) object that represents the *index*th track in *list*.

The [AudioTrackList getTrackById\(id\)](#) and [VideoTrackList getTrackById\(id\)](#) methods must return the first [AudioTrack](#) or [VideoTrack](#) object (respectively) in the [AudioTrackList](#) or [VideoTrackList](#) object (respectively) whose identifier is equal to the value of the *id* argument (in the natural order of the list, as defined above). When no tracks match the given argument, the methods must return null.

The [AudioTrack](#) and [VideoTrack](#) objects represent specific tracks of a [media resource](#). Each track can have an identifier, category, label, and language. These aspects of a track are permanent for the lifetime of the track; even if a track is removed from a [media resource](#)'s [AudioTrackList](#) or [VideoTrackList](#) objects, those aspects do not change.

In addition, [AudioTrack](#) objects can each be enabled or disabled; this is the audio track's *enabled state*. When an [AudioTrack](#) is created, its *enabled state* must be set to false (disabled). The [resource fetch algorithm](#) can override this.

Similarly, a single [VideoTrack](#) object per [VideoTrackList](#) object can be selected, this is the video track's *selection state*. When a [VideoTrack](#) is created, its *selection state* must be set to false (not selected). The [resource fetch algorithm](#) can override this.

The [AudioTrack](#) *id* and [VideoTrack](#) *id* attributes must return the identifier of the track, if it has one, or the empty string otherwise. If the [media resource](#) is in a format that supports [media fragment syntax](#), the identifier returned for a particular track must be the same identifier that would enable the track if used as the name of a track in the track dimension of such a [fragment](#). [\[INBAND\]](#)

For example, in Ogg files, this would be the Name header field of the track.

[\[OGGSKELETONHEADERS\]](#)

The [AudioTrack](#) *kind* and [VideoTrack](#) *kind* attributes must return the category of the track, if it has one, or the empty string otherwise.

The category of a track is the string given in the first column of the table below that is the most appropriate for the track based on the definitions in the table's second and third columns, as determined by the metadata included in the track in the [media resource](#). The cell in the third column of a row says what the category given in the cell in the first column of that row applies to; a category is only appropriate for an audio track if it applies to audio tracks, and a category is only appropriate for video tracks if it applies to video tracks. Categories must only be returned for [AudioTrack](#) objects if they are appropriate for audio, and must only be returned for [VideoTrack](#) objects if they are appropriate for video.

For Ogg files, the Role header field of the track gives the relevant metadata. For DASH media resources, the **Role** element conveys the information. For WebM, only the **FlagDefault** element currently maps to a value. *Sourcing In-band Media Resource Tracks from Media Containers into HTML* has further details. [\[OGGSKELETONHEADERS\]](#) [\[DASH\]](#) [\[WEBMCG\]](#) [\[INBAND\]](#)

Return values for [AudioTrack](#)'s *kind* and [VideoTrack](#)'s *kind*

Category	Definition	Applies to...	Examples
<i>"alternative"</i>	A possible alternative to the main track, e.g. a different take of a song (audio), or a different angle (video).	Audio	Ogg: "audio/alternate" or "video/alternate"; DASH: "alternate" without and "main" and "commentary" roles, and, for video, audio, without the "dub" role (other roles ignored).
<i>"captions"</i>	A version of the main video track with captions burnt in. (For legacy content; new content would use text tracks.)	Video	DASH: "caption" and "main" roles together (other roles ignored).
<i>"descriptions"</i>	An audio description of a video track.	Audio only.	Ogg: "audio/audiodesc".
<i>"main"</i>	The primary audio or video track.	Audio and video.	Ogg: "audio/main" or "video/main"; WebM: the "FlagDefault" element is set; DASH: "main" role without "caption", "subtitle", and "dub" roles (other roles

Category	Definition	Applies to...	Examples
<i>"main-desc"</i>	The primary audio track, mixed with audio descriptions.	Audio only.	AC3 audio in MPEG-2 TS: bsmod=2 and full_svc=1. ignored).
<i>"sign"</i>	A sign-language interpretation of an audio track.	Video only.	Ogg: "video/sign".
<i>"subtitles"</i>	A version of the main video track with subtitles burnt in. (For legacy content; new content would use text tracks.)	Video only.	DASH: "subtitle" and "main" roles together (other roles ignored).
<i>"translation"</i>	A translated version of the main audio track.	Audio only.	Ogg: "audio/dub". DASH: "dub" and "main" roles together (other roles ignored).
<i>"commentary"</i>	Commentary on the primary audio or video track, e.g. a director's commentary.	Audio and video.	DASH: "commentary" role without "main" role (other roles ignored).
"" (empty string)	No explicit kind, or the kind given by the track's metadata is not recognized by the user agent.	Audio and video.	

The [AudioTrack label](#) and [VideoTrack label](#) attributes must return the label of the track, if it has one, or the empty string otherwise. [\[INBAND\]](#)

The [AudioTrack language](#) and [VideoTrack language](#) attributes must return the BCP 47 language tag of the language of the track, if it has one, or the empty string otherwise. If the user agent is not able to express that language as a BCP 47 language tag (for example because the language information in the [media resource](#)'s format is a free-form string without a defined interpretation), then the method must return the empty string, as if the track had no language. [\[INBAND\]](#)

The [AudioTrack enabled](#) attribute, on getting, must return true if the track is currently enabled, and false otherwise. On setting, it must enable the track if the new value is true, and disable it otherwise. (If the track is no longer in an [AudioTrackList](#) object, then the track being enabled or disabled has no effect beyond changing the value of the attribute on the [AudioTrack](#) object.)

Whenever an audio track in an [AudioTrackList](#) that was disabled is enabled, and whenever one that was enabled is disabled, the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [change](#) at the [AudioTrackList](#) object.

An audio track that has no data for a particular position on the [media timeline](#), or that does not exist at that position, must be interpreted as being silent at that point on the timeline.

The [`VideoTrackList selectedIndex`](#) attribute must return the index of the currently selected track, if any. If the [`VideoTrackList`](#) object does not currently represent any tracks, or if none of the tracks are selected, it must instead return `-1`.

The [`VideoTrack selected`](#) attribute, on getting, must return true if the track is currently selected, and false otherwise. On setting, it must select the track if the new value is true, and unselect it otherwise. If the track is in a [`VideoTrackList`](#), then all the other [`VideoTrack`](#) objects in that list must be unselected. (If the track is no longer in a [`VideoTrackList`](#) object, then the track being selected or unselected has no effect beyond changing the value of the attribute on the [`VideoTrack`](#) object.)

Whenever a track in a [`VideoTrackList`](#) that was previously not selected is selected, and whenever the selected track in a [`VideoTrackList`](#) is unselected without a new track being selected in its stead, the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [`change`](#) at the [`VideoTrackList`](#) object. This [`task`](#) must be [queued](#) before the [`task`](#) that fires the [`resize`](#) event, if any.

A video track that has no data for a particular position on the [media timeline](#) must be interpreted as being [transparent black](#) at that point on the timeline, with the same dimensions as the last frame before that position, or, if the position is before all the data for that track, the same dimensions as the first frame for that track. A track that does not exist at all at the current position must be treated as if it existed but had no data.

For instance, if a video has a track that is only introduced after one hour of playback, and the user selects that track then goes back to the start, then the user agent will act as if that track started at the start of the [media resource](#) but was simply transparent until one hour in.

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the [`AudioTrackList`](#) and [`VideoTrackList`](#) interfaces:

	Event handler	Event handler event type
<code>onchange</code>	MDN	change
<code>AudioTrackList/onchange</code>		
Support in all current engines.		
Firefox 33+Safari 7+Chrome 37+		
Opera 24+Edge 79+		

Event handler	Event handler event type
-------------------------------	------------------------------------------

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS 7+Chrome Android 37+WebView

AndroidNoSamsung InternetNoOpera Android 24+

[TextTrackList/onchange](#)

Support in all current engines.

Firefox 31+Safari 7+Chrome 33+

Opera 20+Edge 79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android 31+Safari iOS 7+Chrome Android 33+WebView

Android 4.4+Samsung Internet 2.0+Opera Android 20+

[VideoTrackList/onchange](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS 7+Chrome Android 37+WebView

AndroidNoSamsung InternetNoOpera Android 24+

onaddtrack



[AudioTrackList/onaddtrack](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

[addtrack](#)

Firefox Android 33+Safari iOS 7+Chrome Android 37+WebView

AndroidNoSamsung InternetNoOpera Android 24+

[TextTrackList/onaddtrack](#)

Support in all current engines.

Firefox 31+Safari 6+Chrome 23+

Opera 12.1+Edge 79+

Edge (Legacy)12+Internet Explorer 11

[Event handler](#)

[Event handler event type](#)

Firefox Android31+Safari iOS7+Chrome Android25+WebView
Android37+Samsung Internet1.5+Opera Android12.1+

[VideoTrackList/onaddtrack](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS7+Chrome Android 37+WebView
AndroidNoSamsung InternetNoOpera Android 24+

onremovetrack



[AudioTrackList/onremovetrack](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS7+Chrome Android 37+WebView
AndroidNoSamsung InternetNoOpera Android 24+

[TextTrackList/onremovetrack](#)

Support in all current engines.

[removetrack](#)

Firefox 31+Safari 7+Chrome 33+

Opera 20+Edge 79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android 31+Safari iOS7+Chrome Android 33+WebView
Android 4.4+Samsung Internet 2.0+Opera Android 20+

[VideoTrackList/onremovetrack](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer10+

Firefox Android 33+Safari iOS7+Chrome Android 37+WebView

Event handler	Event handler event type
Android NoSamsung Internet NoOpera Android 24+	

4.8.12.10.2 Selecting specific audio and video tracks declaratively

The [audioTracks](#) and [videoTracks](#) attributes allow scripts to select which track should play, but it is also possible to select specific tracks declaratively, by specifying particular tracks in the [fragment](#) of the [URL](#) of the [media resource](#). The format of the [fragment](#) depends on the [MIME type](#) of the [media resource](#). [\[RFC2046\]](#) [\[URL\]](#)

In this example, a video that uses a format that supports [media fragment syntax](#) is embedded in such a way that the alternative angles labeled "Alternative" are enabled instead of the default video track.

```
<video src="myvideo#track=Alternative"></video>
```

4.8.12.11 Timed text tracks

4.8.12.11.1 Text track model

A [media element](#) can have a group of associated *text tracks*, known as the [media element](#)'s *list of text tracks*. The [text tracks](#) are sorted as follows:

1. The [text tracks](#) corresponding to [track](#) element children of the [media element](#), in [tree order](#).
2. Any [text tracks](#) added using the [addTextTrack\(\)](#) method, in the order they were added, oldest first.
3. Any [media-resource-specific text tracks](#) ([text tracks](#) corresponding to data in the [media resource](#)), in the order defined by the [media resource](#)'s format specification.

A [text track](#) consists of:

The kind of text track

This decides how the track is handled by the user agent. The kind is represented by a string. The possible strings are:

- *subtitles*
- *captions*
- *descriptions*
- *chapters*
- *metadata*

The [kind of track](#) can change dynamically, in the case of a [text track](#) corresponding to a [track](#) element.

A label

This is a human-readable string intended to identify the track for the user.

The [label of a track](#) can change dynamically, in the case of a [text track](#) corresponding to a [track](#) element.

When a [text track label](#) is the empty string, the user agent should automatically generate an appropriate label from the text track's other properties (e.g. the kind of text track and the text track's language) for use in its user interface. This automatically-generated label is not exposed in the API.

An in-band metadata track dispatch type

This is a string extracted from the [media resource](#) specifically for in-band metadata tracks to enable such tracks to be dispatched to different scripts in the document.

For example, a traditional TV station broadcast streamed on the web and augmented with web-specific interactive features could include text tracks with metadata for ad targeting, trivia game data during game shows, player states during sports games, recipe information during food programs, and so forth. As each program starts and ends, new tracks might be added or removed from the stream, and as each one is added, the user agent could bind them to dedicated script modules using the value of this attribute.

Other than for in-band metadata text tracks, the [in-band metadata track dispatch type](#) is the empty string. How this value is populated for different media formats is described in [steps to expose a media-resource-specific text track](#).

A language

This is a string (a BCP 47 language tag) representing the language of the text track's cues. [\[BCP47\]](#)

The [language of a text track](#) can change dynamically, in the case of a [text track](#) corresponding to a [track](#) element.

A readiness state

One of the following:

Not loaded

Indicates that the text track's cues have not been obtained.

Loading

Indicates that the text track is loading and there have been no fatal errors encountered so far. Further cues might still be added to the track by the parser.

Loaded

Indicates that the text track has been loaded with no fatal errors.

Failed to load

Indicates that the text track was enabled, but when the user agent attempted to obtain it, this failed in some way (e.g. [URL](#) could not be [parsed](#), network error, unknown text track format). Some or all of the cues are likely missing and will not be obtained.

The [readiness state](#) of a [text track](#) changes dynamically as the track is obtained.

A mode

One of the following:

Disabled

Indicates that the text track is not active. Other than for the purposes of exposing the track in the DOM, the user agent is ignoring the text track. No cues are active, no events are fired, and the user agent will not attempt to obtain the track's cues.

Hidden

Indicates that the text track is active, but that the user agent is not actively displaying the cues. If no attempt has yet been made to obtain the track's cues, the user agent will perform such an attempt momentarily. The user agent is maintaining a list of which cues are active, and events are being fired accordingly.

Showing

Indicates that the text track is active. If no attempt has yet been made to obtain the track's cues, the user agent will perform such an attempt momentarily. The user agent is maintaining a list of which cues are active, and events are being fired accordingly. In addition, for text tracks whose [kind](#) is [subtitles](#) or [captions](#), the cues are being overlaid on the video as appropriate; for text tracks whose [kind](#) is [descriptions](#), the user agent is making the cues available to the user in a non-visual fashion; and for text tracks whose [kind](#) is [chapters](#), the user agent is making available to the user a mechanism by which the user can navigate to any point in the [media resource](#) by selecting a cue.

A list of zero or more cues

A list of [text track cues](#), along with *rules for updating the text track rendering*. For example, for WebVTT, the [rules for updating the display of WebVTT text tracks](#).
[[WEBVTT](#)]

The [list of cues of a text track](#) can change dynamically, either because the [text track](#) has

[not yet been loaded](#) or is still [loading](#), or due to DOM manipulation.

Each [text track](#) has a corresponding [TextTrack](#) object.

Each [media element](#) has a *list of pending text tracks*, which must initially be empty, a [blocked-on-parser](#) flag, which must initially be false, and a [did-perform-automatic-track-selection](#) flag, which must also initially be false.

When the user agent is required to *populate the list of pending text tracks* of a [media element](#), the user agent must add to the element's [list of pending text tracks](#) each [text track](#) in the element's [list of text tracks](#) whose [text track mode](#) is not [disabled](#) and whose [text track readiness state](#) is [loading](#).

Whenever a [track](#) element's parent node changes, the user agent must remove the corresponding [text track](#) from any [list of pending text tracks](#) that it is in.

Whenever a [text track](#)'s [text track readiness state](#) changes to either [loaded](#) or [failed to load](#), the user agent must remove it from any [list of pending text tracks](#) that it is in.

When a [media element](#) is created by an [HTML parser](#) or [XML parser](#), the user agent must set the element's [blocked-on-parser](#) flag to true. When a [media element](#) is popped off the [stack of open elements](#) of an [HTML parser](#) or [XML parser](#), the user agent must [honor user preferences for automatic text track selection](#), [populate the list of pending text tracks](#), and set the element's [blocked-on-parser](#) flag to false.

The [text tracks](#) of a [media element](#) are *ready* when both the element's [list of pending text tracks](#) is empty and the element's [blocked-on-parser](#) flag is false.

Each [media element](#) has a *pending text track change notification flag*, which must initially be unset.

Whenever a [text track](#) that is in a [media element](#)'s [list of text tracks](#) has its [text track mode](#) change value, the user agent must run the following steps for the [media element](#):

1. If the [media element](#)'s [pending text track change notification flag](#) is set, return.
2. Set the [media element](#)'s [pending text track change notification flag](#).
3. [Queue a media element task](#) given the [media element](#) to run these steps:
 1. Unset the [media element](#)'s [pending text track change notification flag](#).
 2. [Fire an event](#) named [change](#) at the [media element](#)'s [textTracks](#) attribute's [TextTrackList](#) object.
4. If the [media element](#)'s [show poster](#) flag is not set, run the [time marches on](#) steps.

The [task source](#) for the [tasks](#) listed in this section is the [DOM manipulation task source](#).

A *text track cue* is the unit of time-sensitive data in a [text track](#), corresponding for instance for subtitles and captions to the text that appears at a particular time and disappears at another time.

Each [text track cue](#) consists of:

An identifier

An arbitrary string.

A start time

The time, in seconds and fractions of a second, that describes the beginning of the range of the [media data](#) to which the cue applies.

An end time

The time, in seconds and fractions of a second, that describes the end of the range of the [media data](#) to which the cue applies, or positive Infinity for an [unbounded text track cue](#).

A pause-on-exit flag

A boolean indicating whether playback of the [media resource](#) is to pause when the end of the range to which the cue applies is reached.

Some additional format-specific data

Additional fields, as needed for the format, including the actual data of the cue. For example, WebVTT has a [text track cue writing direction](#) and so forth. [\[WEBVTT\]](#)

An *unbounded text track cue* is a text track cue with a [text track cue end time](#) set to positive Infinity. An active [unbounded text track cue](#) cannot become inactive through the usual monotonic increase of the [current playback position](#) during normal playback (e.g. a metadata cue for a chapter in a live event with no announced end time.)

The [text track cue start time](#) and [text track cue end time](#) can be negative. (The [current playback position](#) can never be negative, though, so cues entirely before time zero cannot be active.)

Each [text track cue](#) has a corresponding [TextTrackCue](#) object (or more specifically, an object that inherits from [TextTrackCue](#) — for example, WebVTT cues use the [VTCue](#) interface). A [text track cue](#)'s in-memory representation can be dynamically changed through this [TextTrackCue](#) API. [\[WEBVTT\]](#)

A [text track cue](#) is associated with [rules for updating the text track rendering](#), as defined by the

specification for the specific kind of [text track cue](#). These rules are used specifically when the object representing the cue is added to a [TextTrack](#) object using the [addCue\(\)](#) method.

In addition, each [text track cue](#) has two pieces of dynamic information:

The *active flag*

This flag must be initially unset. The flag is used to ensure events are fired appropriately when the cue becomes active or inactive, and to make sure the right cues are rendered.

The user agent must synchronously unset this flag whenever the [text track cue](#) is removed from its [text track's text track list of cues](#); whenever the [text track](#) itself is removed from its [media element's list of text tracks](#) or has its [text track mode](#) changed to [disabled](#); and whenever the [media element's readyState](#) is changed back to [HAVE NOTHING](#). When the flag is unset in this way for one or more cues in [text tracks](#) that were [showing](#) prior to the relevant incident, the user agent must, after having unset the flag for all the affected cues, apply the [rules for updating the text track rendering](#) of those [text tracks](#). For example, for [text tracks](#) based on WebVTT, the [rules for updating the display of WebVTT text tracks](#). [WEBVTT]

The *display state*

This is used as part of the rendering model, to keep cues in a consistent position. It must initially be empty. Whenever the [text track cue active flag](#) is unset, the user agent must empty the [text track cue display state](#).

The [text track cues](#) of a [media element's text tracks](#) are ordered relative to each other in the [text track cue order](#), which is determined as follows: first group the [cues](#) by their [text track](#), with the groups being sorted in the same order as their [text tracks](#) appear in the [media element's list of text tracks](#); then, within each group, [cues](#) must be sorted by their [start time](#), earliest first; then, any [cues](#) with the same [start time](#) must be sorted by their [end time](#), latest first; and finally, any [cues](#) with identical [end times](#) must be sorted in the order they were last added to their respective [text track list of cues](#), oldest first (so e.g. for cues from a WebVTT file, that would initially be the order in which the cues were listed in the file). [WEBVTT]

4.8.12.11.2 Sourcing in-band text tracks

A *media-resource-specific text track* is a [text track](#) that corresponds to data found in the [media resource](#).

Rules for processing and rendering such data are defined by the relevant specifications, e.g. the specification of the video format if the [media resource](#) is a video. Details for some legacy formats can be found in *Sourcing In-band Media Resource Tracks from Media Containers into HTML*. [INBAND]

When a [media resource](#) contains data that the user agent recognizes and supports as being equivalent to a [text track](#), the user agent [runs](#) the *steps to expose a media-resource-specific text*

track with the relevant data, as follows.

1. Associate the relevant data with a new [text track](#) and its corresponding new [TextTrack](#) object. The [text track](#) is a [media-resource-specific text track](#).
2. Set the new [text track's kind](#), [label](#), and [language](#) based on the semantics of the relevant data, as defined by the relevant specification. If there is no label in that data, then the [label](#) must be set to the empty string.
3. Associate the [text track list of cues](#) with the [rules for updating the text track rendering](#) appropriate for the format in question.
4. If the new [text track's kind](#) is [chapters](#) or [metadata](#), then set the [text track in-band metadata track dispatch type](#) as follows, based on the type of the [media resource](#):

If the [media resource](#) is an Ogg file

The [text track in-band metadata track dispatch type](#) must be set to the value of the Name header field. [\[OGGSKELETONHEADERS\]](#)

If the [media resource](#) is a WebM file

The [text track in-band metadata track dispatch type](#) must be set to the value of the [CodecID](#) element. [\[WEBMCG\]](#)

If the [media resource](#) is an MPEG-2 file

Let *stream type* be the value of the "stream_type" field describing the text track's type in the file's program map section, interpreted as an 8-bit unsigned integer. Let *length* be the value of the "ES_info_length" field for the track in the same part of the program map section, interpreted as an integer as defined by *Generic coding of moving pictures and associated audio information*. Let *descriptor bytes* be the *length* bytes following the "ES_info_length" field. The [text track in-band metadata track dispatch type](#) must be set to the concatenation of the *stream type* byte and the zero or more *descriptor bytes* bytes, expressed in hexadecimal using [ASCII upper hex digits](#). [\[MPEG2\]](#)

If the [media resource](#) is an MPEG-4 file

Let the first **stsd** box of the first **stbl** box of the first **minf** box of the first **mdia** box of the [text track](#)'s **trak** box in the first **moov** box of the file be the *stsd box*, if any. If the file has no *stsd box*, or if the *stsd box* has neither a **mett** box nor a **metx** box, then the [text track in-band metadata track dispatch type](#) must be set to the empty string. Otherwise, if the *stsd box* has a **mett** box then the [text track in-band metadata track dispatch type](#) must be set to the concatenation of the string "**mett**", a U+0020 SPACE character, and the value of the first **mime_format** field of the first **mett** box of the *stsd box*, or the empty string if that field is absent in that box. Otherwise, if the *stsd box* has no **mett** box but has a **metx** box then the [text track in-band metadata track dispatch type](#) must be set to the concatenation of the string "**metx**", a U+0020 SPACE character, and the value of the first **namespace** field of the first **metx** box of the *stsd box*, or the empty string if that field is absent in that

box. [MPEG4]

5. Populate the new [text track](#)'s [list of cues](#) with the cues parsed so far, following the [guidelines for exposing cues](#), and begin updating it dynamically as necessary.
6. Set the new [text track](#)'s [readiness state](#) to [loaded](#).
7. Set the new [text track](#)'s [mode](#) to the mode consistent with the user's preferences and the requirements of the relevant specification for the data.

For instance, if there are no other active subtitles, and this is a forced subtitle track (a subtitle track giving subtitles in the audio track's primary language, but only for audio that is actually in another language), then those subtitles might be activated here.
8. Add the new [text track](#) to the [media element](#)'s [list of text tracks](#).
9. [Fire an event](#) named [addtrack](#) at the [media element](#)'s [textTracks](#) attribute's [TextTrackList](#) object, using [TrackEvent](#), with the [track](#) attribute initialized to the [text track](#)'s [TextTrack](#) object.

4.8.12.11.3 Sourcing out-of-band text tracks

When a [track](#) element is created, it must be associated with a new [text track](#) (with its value set as defined below) and its corresponding new [TextTrack](#) object.

The [text track kind](#) is determined from the state of the element's [kind](#) attribute according to the following table; for a state given in a cell of the first column, the [kind](#) is the string given in the second column:

State	String
Subtitles	subtitles
Captions	captions
Descriptions	descriptions
Chapters metadata	chapters
Metadata	metadata

The [text track label](#) is the element's [track label](#).

The [text track language](#) is the element's [track language](#), if any, or the empty string otherwise.

As the [kind](#), [label](#), and [srclang](#) attributes are set, changed, or removed, the [text track](#) must update accordingly, as per the definitions above.

Changes to the [track URL](#) are handled in the algorithm below.

The [text track readiness state](#) is initially [not loaded](#), and the [text track mode](#) is initially

[disabled](#).

The [text track list of cues](#) is initially empty. It is dynamically modified when the referenced file is parsed. Associated with the list are the [rules for updating the text track rendering](#) appropriate for the format in question; for WebVTT, this is the [rules for updating the display of WebVTT text tracks](#). [WEBVTT]

When a [track](#) element's parent element changes and the new parent is a [media element](#), then the user agent must add the [track](#) element's corresponding [text track](#) to the [media element's list of text tracks](#), and then [queue a media element task](#) given the [media element](#) to fire an event named [addtrack](#) at the [media element's textTracks attribute's TextTrackList object](#), using [TrackEvent](#), with the [track](#) attribute initialized to the [text track's TextTrack object](#).

When a [track](#) element's parent element changes and the old parent was a [media element](#), then the user agent must remove the [track](#) element's corresponding [text track](#) from the [media element's list of text tracks](#), and then [queue a media element task](#) given the [media element](#) to fire an event named [removetrack](#) at the [media element's textTracks attribute's TextTrackList object](#), using [TrackEvent](#), with the [track](#) attribute initialized to the [text track's TextTrack object](#).

When a [text track](#) corresponding to a [track](#) element is added to a [media element's list of text tracks](#), the user agent must [queue a media element task](#) given the [media element](#) to run the following steps for the [media element](#):

1. If the element's [blocked-on-parser](#) flag is true, then return.
2. If the element's [did-perform-automatic-track-selection](#) flag is true, then return.
3. [Honor user preferences for automatic text track selection](#) for this element.

When the user agent is required to *honor user preferences for automatic text track selection* for a [media element](#), the user agent must run the following steps:

1. [Perform automatic text track selection](#) for [subtitles](#) and [captions](#).
2. [Perform automatic text track selection](#) for [descriptions](#).
3. If there are any [text tracks](#) in the [media element's list of text tracks](#) whose [text track kind](#) is [chapters](#) or [metadata](#) that correspond to [track](#) elements with a [default](#) attribute set whose [text track mode](#) is set to [disabled](#), then set the [text track mode](#) of all such tracks to [hidden](#)
4. Set the element's [did-perform-automatic-track-selection](#) flag to true.

When the steps above say to *perform automatic text track selection* for one or more [text track](#)

kinds, it means to run the following steps:

1. Let *candidates* be a list consisting of the text tracks in the media element's list of text tracks whose text track kind is one of the kinds that were passed to the algorithm, if any, in the order given in the list of text tracks.
2. If *candidates* is empty, then return.
3. If any of the text tracks in *candidates* have a text track mode set to showing, return.
4. If the user has expressed an interest in having a track from *candidates* enabled based on its text track kind, text track language, and text track label, then set its text track mode to showing.

For example, the user could have set a browser preference to the effect of "I want French captions whenever possible", or "If there is a subtitle track with 'Commentary' in the title, enable it", or "If there are audio description tracks available, enable one, ideally in Swiss German, but failing that in Standard Swiss German or Standard German".

Otherwise, if there are any text tracks in *candidates* that correspond to track elements with a default attribute set whose text track mode is set to disabled, then set the text track mode of the first such track to showing.

When a text track corresponding to a track element experiences any of the following circumstances, the user agent must start the track processing model for that text track and its track element:

- The track element is created.
- The text track has its text track mode changed.
- The track element's parent element changes and the new parent is a media element.

When a user agent is to start the track processing model for a text track and its track element, it must run the following algorithm. This algorithm interacts closely with the event loop mechanism; in particular, it has a synchronous section (which is triggered as part of the event loop algorithm). The steps in that section are marked with ☒.

1. If another occurrence of this algorithm is already running for this text track and its track element, return, letting that other algorithm take care of this element.
2. If the text track's text track mode is not set to one of hidden or showing, then return.
3. If the text track's track element does not have a media element as a parent, return.
4. Run the remainder of these steps in parallel, allowing whatever caused these steps to run to continue.
5. *Top: Await a stable state.* The synchronous section consists of the following steps. (The

steps in the [synchronous section](#) are marked with ☒.)

6. ☒ Set the [text track readiness state](#) to [loading](#).
7. ☒ Let *URL* be the [track URL](#) of the [track](#) element.
8. ☒ If the [track](#) element's parent is a [media element](#) then let *corsAttributeState* be the state of the parent [media element](#)'s [crossorigin](#) content attribute. Otherwise, let *corsAttributeState* be [No CORS](#).
9. End the [synchronous section](#), continuing the remaining steps [in parallel](#).
10. If *URL* is not the empty string, then:
 1. Let *request* be the result of [creating a potential-CORS request](#) given *URL*, "track", and *corsAttributeState*, and with the *same-origin fallback flag* set.
 2. Set *request*'s [client](#) to the [track](#) element's [node document](#)'s [relevant settings object](#).
 3. [Fetch request](#).

The [tasks queued](#) by the fetching algorithm on the [networking task source](#) to process the data as it is being fetched must determine the type of the resource. If the type of the resource is not a supported text track format, the load will fail, as described below. Otherwise, the resource's data must be passed to the appropriate parser (e.g., the [WebVTT parser](#)) as it is received, with the [text track list of cues](#) being used for that parser's output. [\[WEBVTT\]](#)

The appropriate parser will incrementally update the [text track list of cues](#) during these [networking task source tasks](#), as each such task is run with whatever data has been received from the network).

This specification does not currently say whether or how to check the MIME types of text tracks, or whether or how to perform file type sniffing using the actual file data. Implementers differ in their intentions on this matter and it is therefore unclear what the right solution is. In the absence of any requirement here, the HTTP specifications' strict requirement to follow the Content-Type header prevails ("Content-Type specifies the media type of the underlying data." ... "If and only if the media type is not given by a Content-Type field, the recipient MAY attempt to guess the media type via inspection of its content and/or the name extension(s) of the URI used to identify the resource.").

If fetching fails for any reason (network error, the server returns an error code, CORS fails, etc.), or if *URL* is the empty string, then [queue an element task](#) on the [DOM manipulation task source](#) given the [media element](#) to first change the [text track readiness state](#) to [failed to load](#) and then [fire an event](#) named [error](#) at the [track](#) element.

If fetching does not fail, but the type of the resource is not a supported text track format, or the file was not successfully processed (e.g., the format in question is an XML format and the file contained a well-formedness error that XML requires be detected and reported to the application), then the [task](#) that is [queued](#) on the [networking task source](#) in which the aforementioned problem is found must change the [text track readiness state](#) to [failed to load](#) and [fire an event](#) named [error](#) at the [track](#) element.

If fetching does not fail, and the file was successfully processed, then the final [task](#) that is [queued](#) by the [networking task source](#), after it has finished parsing the data, must change the [text track readiness state](#) to [loaded](#), and [fire an event](#) named [load](#) at the [track](#) element.

If, while fetching is ongoing, either:

- the [track URL](#) changes so that it is no longer equal to [URL](#), while the [text track mode](#) is set to [hidden](#) or [showing](#); or
- the [text track mode](#) changes to [hidden](#) or [showing](#), while the [track URL](#) is not equal to [URL](#)

...then the user agent must abort [fetching](#), discarding any pending [tasks](#) generated by that algorithm (and in particular, not adding any cues to the [text track list of cues](#) after the moment the URL changed), and then [queue an element task](#) on the [DOM manipulation task source](#) given the [track](#) element that first changes the [text track readiness state](#) to [failed to load](#) and then [fires an event](#) named [error](#) at the [track](#) element.

11. Wait until the [text track readiness state](#) is no longer set to [loading](#).
12. Wait until the [track URL](#) is no longer equal to [URL](#), at the same time as the [text track mode](#) is set to [hidden](#) or [showing](#).
13. Jump to the step labeled *top*.

Whenever a [track](#) element has its [src](#) attribute set, changed, or removed, the user agent must [immediately](#) empty the element's [text track](#)'s [text track list of cues](#). (This also causes the algorithm above to stop adding cues from the resource being obtained using the previously given URL, if any.)

4.8.12.11.4 Guidelines for exposing cues in various formats as [text track cues](#)

How a specific format's text track cues are to be interpreted for the purposes of processing by an HTML user agent is defined by that format. In the absence of such a specification, this section provides some constraints within which implementations can attempt to consistently expose such formats.

To support the [text track](#) model of HTML, each unit of timed data is converted to a [text track cue](#). Where the mapping of the format's features to the aspects of a [text track cue](#) as defined in

this specification are not defined, implementations must ensure that the mapping is consistent with the definitions of the aspects of a [text track cue](#) as defined above, as well as with the following constraints:

The [text track cue identifier](#)

Should be set to the empty string if the format has no obvious analogue to a per-cue identifier.

The [text track cue pause-on-exit flag](#)

Should be set to false.

4.8.12.11.5 Text track API



[TextTrackList](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12.1+

```
[Exposed=Window]
interface TextTrackList : EventTarget {
  readonly attribute unsigned long length;
  getter TextTrack (unsigned long index);
  TextTrack? getTrackById(DOMString id);

  attribute EventHandler onchange;
  attribute EventHandler onaddtrack;
  attribute EventHandler onremovetrack;
};

media.textTracks.length
```



[HTMLMediaElement/textTracks](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android31+Safari iOS6+Chrome Android25+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns the number of [text tracks](#) associated with the [media element](#) (e.g. from [track](#) elements). This is the number of [text tracks](#) in the [media element's list of text tracks](#).

`media.textTracks[n]`

Returns the [TextTrack](#) object representing the *n*th [text track](#) in the [media element's list of text tracks](#).

`textTrack = media.textTracks.getTrackById(id)`



[TextTrackList/getTrackById](#)

Support in all current engines.

Firefox31+Safari7+Chrome33+

Opera20+Edge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android31+Safari iOS8+Chrome Android33+WebView Android4.4.3+Samsung Internet2.0+Opera Android20+

Returns the [TextTrack](#) object with the given identifier, or null if no track has that identifier.

A [TextTrackList](#) object represents a dynamically updating list of [text tracks](#) in a given order.

The [textTracks](#) attribute of [media elements](#) must return a [TextTrackList](#) object representing the [TextTrack](#) objects of the [text tracks](#) in the [media element's list of text tracks](#), in the same order as in the [list of text tracks](#).



[TextTrackList/length](#)

Support in all current engines.

Firefox31+Safari6+Chrome44+

Opera31+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android31+Safari iOS7+Chrome Android44+WebView Android44+Samsung

Internet4.0+Opera Android32+

The `length` attribute of a `TextTrackList` object must return the number of `text tracks` in the list represented by the `TextTrackList` object.

The `supported property indices` of a `TextTrackList` object at any instant are the numbers from zero to the number of `text tracks` in the list represented by the `TextTrackList` object minus one, if any. If there are no `text tracks` in the list, there are no `supported property indices`.

To `determine the value of an indexed property` of a `TextTrackList` object for a given index `index`, the user agent must return the `index`th `text track` in the list represented by the `TextTrackList` object.

The `getTrackById(id)` method must return the first `TextTrack` in the `TextTrackList` object whose `id` IDL attribute would return a value equal to the value of the `id` argument. When no tracks match the given argument, the method must return null.



[TextTrack](#)

Support in all current engines.

Firefox31+Safari6+Chrome23+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android31+Safari iOS7+Chrome Android25+WebView Android4.4+Samsung Internet1.5+Opera Android12.1+

```
enum TextTrackMode { "disabled", "hidden", "showing" };
enum TextTrackKind { "subtitles", "captions", "descriptions", "chapters",
```

[Exposed=Window]

```
interface TextTrack : EventTarget {
  readonly attribute TextTrackKind kind;
  readonly attribute DOMString label;
  readonly attribute DOMString language;

  readonly attribute DOMString id;
  readonly attribute DOMString inBandMetadataTrackDispatchType;

  attribute TextTrackMode mode;

  readonly attribute TextTrackCueList? cues;
  readonly attribute TextTrackCueList? activeCues;
```

```
undefined addCue\(TextTrackCue cue\);  
undefined removeCue\(TextTrackCue cue\);  
  
attribute EventHandler oncuechange;  
};  
  
textTrack = media.addTextTrack(kind [, label [, language ] ])
```

Creates and returns a new [TextTrack](#) object, which is also added to the [media element's list of text tracks](#).

textTrack.kind

Returns the [text track kind](#) string.

textTrack.label

Returns the [text track label](#), if there is one, or the empty string otherwise (indicating that a custom label probably needs to be generated from the other attributes of the object if the object is exposed to the user).

textTrack.language

Returns the [text track language](#) string.

textTrack.id

Returns the ID of the given track.

For in-band tracks, this is the ID that can be used with a [fragment](#) if the format supports [media fragment syntax](#), and that can be used with the [getTrackById\(\)](#) method.

For [TextTrack](#) objects corresponding to [track](#) elements, this is the ID of the [track](#) element.

textTrack.inBandMetadataTrackDispatchType

Returns the [text track in-band metadata track dispatch type](#) string.

textTrack.mode [= value]

✓MDN

[TextTrack mode](#)

Support in all current engines.

Firefox31+Safari6+Chrome23+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android31+Safari iOS7+Chrome Android25+WebView Android4.4+Samsung Internet1.5+Opera Android12.1+

Returns the [text track mode](#), represented by a string from the following list:

"disabled"

The [text track disabled](#) mode.

"hidden"

The [text track hidden](#) mode.

"showing"

The [text track showing](#) mode.

Can be set, to change the mode.

`textTrack.cues`

Returns the [text track list of cues](#), as a [TextTrackCueList](#) object.

`textTrack.activeCues`

Returns the [text track cues](#) from the [text track list of cues](#) that are currently active (i.e. that start before the [current playback position](#) and end after it), as a [TextTrackCueList](#) object.

`textTrack.addCue(cue)`

Adds the given cue to *textTrack*'s [text track list of cues](#).

`textTrack.removeCue(cue)`

Removes the given cue from *textTrack*'s [text track list of cues](#).

The `addTextTrack(kind, label, language)` method of [media elements](#), when invoked, must run the following steps:

1. Create a new [TextTrack](#) object.
2. Create a new [text track](#) corresponding to the new object, and set its [text track kind](#) to *kind*, its [text track label](#) to *label*, its [text track language](#) to *language*, its [text track readiness state](#) to the [text track loaded](#) state, its [text track mode](#) to the [text track](#)

[hidden](#) mode, and its [text track list of cues](#) to an empty list.

Initially, the [text track list of cues](#) is not associated with any [rules for updating the text track rendering](#). When a [text track cue](#) is added to it, the [text track list of cues](#) has its rules permanently set accordingly.

3. Add the new [text track](#) to the [media element's list of text tracks](#).
 4. Queue a media element task given the [media element](#) to fire an event named [addtrack](#) at the [media element's textTracks](#) attribute's [TextTrackList](#) object, using [TrackEvent](#), with the [track](#) attribute initialized to the new [text track's TextTrack](#) object.
 5. Return the new [TextTrack](#) object.
-

The *kind* attribute must return the [text track kind](#) of the [text track](#) that the [TextTrack](#) object represents.

The *label* attribute must return the [text track label](#) of the [text track](#) that the [TextTrack](#) object represents.

The *language* attribute must return the [text track language](#) of the [text track](#) that the [TextTrack](#) object represents.

The *id* attribute returns the track's identifier, if it has one, or the empty string otherwise. For tracks that correspond to [track](#) elements, the track's identifier is the value of the element's [id](#) attribute, if any. For in-band tracks, the track's identifier is specified by the [media resource](#). If the [media resource](#) is in a format that supports [media fragment syntax](#), the identifier returned for a particular track must be the same identifier that would enable the track if used as the name of a track in the track dimension of such a [fragment](#).

The *inBandMetadataTrackDispatchType* attribute must return the [text track in-band metadata track dispatch type](#) of the [text track](#) that the [TextTrack](#) object represents.

The *mode* attribute, on getting, must return the string corresponding to the [text track mode](#) of the [text track](#) that the [TextTrack](#) object represents, as defined by the following list:

"disabled"

The [text track disabled](#) mode.

"hidden"

The [text track hidden](#) mode.

"showing"

The [text track showing](#) mode.

On setting, if the new value isn't equal to what the attribute would currently return, the new value must be processed as follows:

If the new value is "**disabled**"

Set the text track mode of the text track that the TextTrack object represents to the text track disabled mode.

If the new value is "**hidden**"

Set the text track mode of the text track that the TextTrack object represents to the text track hidden mode.

If the new value is "**showing**"

Set the text track mode of the text track that the TextTrack object represents to the text track showing mode.

If the text track mode of the text track that the TextTrack object represents is not the text track disabled mode, then the cues attribute must return a live TextTrackCueList object that represents the subset of the text track list of cues of the text track that the TextTrack object represents whose end times occur at or after the earliest possible position when the script started, in text track cue order. Otherwise, it must return null. For each TextTrack object, when an object is returned, the same TextTrackCueList object must be returned each time.

The earliest possible position when the script started is whatever the earliest possible position was the last time the event loop reached step 1.

If the text track mode of the text track that the TextTrack object represents is not the text track disabled mode, then the activeCues attribute must return a live TextTrackCueList object that represents the subset of the text track list of cues of the text track that the TextTrack object represents whose active flag was set when the script started, in text track cue order. Otherwise, it must return null. For each TextTrack object, when an object is returned, the same TextTrackCueList object must be returned each time.

A text track cue's active flag was set when the script started if its text track cue active flag was set the last time the event loop reached step 1.

The addCue(cue) method of TextTrack objects, when invoked, must run the following steps:

1. If the text track list of cues does not yet have any associated rules for updating the text track rendering, then associate the text track list of cues with the rules for updating the text track rendering appropriate to cue.
2. If text track list of cues' associated rules for updating the text track rendering are not

the same [rules for updating the text track rendering](#) as appropriate for *cue*, then throw an ["InvalidStateError" DOMException](#).

3. If the given *cue* is in a [text track list of cues](#), then remove *cue* from that [text track list of cues](#).
4. Add *cue* to the [TextTrack](#) object's [text track](#)'s [text track list of cues](#).

The `removeCue(cue)` method of [TextTrack](#) objects, when invoked, must run the following steps:

1. If the given *cue* is not in the [TextTrack](#) object's [text track](#)'s [text track list of cues](#), then throw a ["NotFoundError" DOMException](#).
2. Remove *cue* from the [TextTrack](#) object's [text track](#)'s [text track list of cues](#).

In this example, an [audio](#) element is used to play a specific sound-effect from a sound file containing many sound effects. A cue is used to pause the audio, so that it ends exactly at the end of the clip, even if the browser is busy running some script. If the page had relied on script to pause the audio, then the start of the next clip might be heard if the browser was not able to run the script at the exact time specified.

```
var sfx = new Audio('sfx.wav');
var sounds = sfx.addTextTrack('metadata');

// add sounds we care about
function addFX(start, end, name) {
  var cue = new VTTcue(start, end, '');
  cue.id = name;
  cue.pauseOnExit = true;
  sounds.addCue(cue);
}
addFX(12.783, 13.612, 'dog bark');
addFX(13.612, 15.091, 'kitten mew'))

function playSound(id) {
  sfx.currentTime = sounds.getCueById(id).startTime;
  sfx.play();
}

// play a bark as soon as we can
sfx.oncanplaythrough = function () {
  playSound('dog bark');
}
// meow when the user tries to leave,
// and have the browser ask them to stay
window.onbeforeunload = function (e) {
```

```
playSound('kitten mew');
e.preventDefault();
}
```



[TextTrackCueList](#)

Support in all current engines.

Firefox 31+ | Safari 6+ | Chrome 23+

Opera 12.1+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 10+

Firefox Android 31+ | Safari iOS 6+ | Chrome Android 25+ | WebView Android 37+ | Samsung Internet 1.5+ | Opera Android 12.1+

[Exposed=Window]

```
interface TextTrackCueList {
  readonly attribute unsigned long length;
  getter TextTrackCue (unsigned long index);
  TextTrackCue? getcueById(DOMString id);
};
```

cuelist.length

Returns the number of [cues](#) in the list.

cuelist[index]

Returns the [text track cue](#) with index *index* in the list. The cues are sorted in [text track cue order](#).

cuelist.getcueById(id)

Returns the first [text track cue](#) (in [text track cue order](#)) with [text track cue identifier](#) *id*.

Returns null if none of the cues have the given identifier or if the argument is the empty string.

A [TextTrackCueList](#) object represents a dynamically updating list of [text track cues](#) in a given order.



[TextTrackCueList/length](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 6+ Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 12.1+

The `length` attribute must return the number of [cues](#) in the list represented by the [TextTrackCueList](#) object.

The [supported property indices](#) of a [TextTrackCueList](#) object at any instant are the numbers from zero to the number of [cues](#) in the list represented by the [TextTrackCueList](#) object minus one, if any. If there are no [cues](#) in the list, there are no [supported property indices](#).

To [determine the value of an indexed property](#) for a given index `index`, the user agent must return the `index`th [text track cue](#) in the list represented by the [TextTrackCueList](#) object.



[TextTrackCueList/getCueById](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 6+ Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 12.1+

The `getCueById(id)` method, when called with an argument other than the empty string, must return the first [text track cue](#) in the list represented by the [TextTrackCueList](#) object whose [text track cue identifier](#) is `id`, if any, or null otherwise. If the argument is the empty string, then the method must return null.



[TextTrackCue](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung

Internet1.5+ Opera Android12.1+

```
[Exposed=Window]
interface TextTrackCue : EventTarget {
  readonly attribute TextTrack? track;

  attribute DOMString id;
  attribute double startTime;
  attribute unrestricted double endTime;
  attribute boolean pauseOnExit;

  attribute EventHandler onenter;
  attribute EventHandler onexit;
};
```

`cue.track`

Returns the [TextTrack](#) object to which this [text track cue](#) belongs, if any, or null otherwise.

`cue.id [= value]`

Returns the [text track cue identifier](#).

Can be set.

`cue.startTime [= value]`

Returns the [text track cue start time](#), in seconds.

Can be set.

`cue.endTime [= value]`

Returns the [text track cue end time](#), in seconds.

Returns positive Infinity for an [unbounded text track cue](#).

Can be set.

`cue.pauseOnExit [= value]`

Returns true if the [text track cue pause-on-exit flag](#) is set, false otherwise.

Can be set.

[TextTrackCue/track](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12.1+

The *track* attribute, on getting, must return the [TextTrack](#) object of the [text track](#) in whose [list of cues](#) the [text track cue](#) that the [TextTrackCue](#) object represents finds itself, if any; or null otherwise.



[TextTrackCue/id](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12.1+

The *id* attribute, on getting, must return the [text track cue identifier](#) of the [text track cue](#) that the [TextTrackCue](#) object represents. On setting, the [text track cue identifier](#) must be set to the new value.



[TextTrackCue/startTime](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12.1+

The *startTime* attribute, on getting, must return the [text track cue start time](#) of the [text track cue](#) that the [TextTrackCue](#) object represents, in seconds. On setting, the [text track cue start time](#) must be set to the new value, interpreted in seconds; then, if the [TextTrackCue](#)

object's [text track cue](#) is in a [text track's list of cues](#), and that [text track](#) is in a [media element's list of text tracks](#), and the [media element's show poster flag](#) is not set, then run the [time marches on](#) steps for that [media element](#).



[TextTrackCue/endTime](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12.1+

The [endTime](#) attribute, on getting, must return the [text track cue end time](#) of the [text track cue](#) that the [TextTrackCue](#) object represents, in seconds or positive Infinity. On setting, if the new value is negative Infinity or a Not-a-Number (NaN) value, then throw a [TypeError](#) exception. Otherwise, the [text track cue end time](#) must be set to the new value. Then, if the [TextTrackCue](#) object's [text track cue](#) is in a [text track's list of cues](#), and that [text track](#) is in a [media element's list of text tracks](#), and the [media element's show poster flag](#) is not set, then run the [time marches on](#) steps for that [media element](#).



[TextTrackCue/pauseOnExit](#)

Support in all current engines.

Firefox 31+ Safari 6+ Chrome 23+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 12.1+

The [pauseOnExit](#) attribute, on getting, must return true if the [text track cue pause-on-exit flag](#) of the [text track cue](#) that the [TextTrackCue](#) object represents is set; or false otherwise. On setting, the [text track cue pause-on-exit flag](#) must be set if the new value is true, and must be unset otherwise.

4.8.12.11.6 Event handlers for objects of the text track APIs

The following are the [event handlers](#) that (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the

[TextTrackList](#) interface:

<u>Event handler</u>	<u>Event handler event type</u>
<i>onchange</i>	<u>change</u>
<i>onaddtrack</i>	<u>addtrack</u>
<i>onremovetrack</i>	<u>removetrack</u>

The following are the [event handlers](#) that (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the [TextTrack](#) interface:

<u>Event handler</u>	<u>Event handler event type</u>
<i>oncuechange</i>	<u>cuechange</u>

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the [TextTrackCue](#) interface:

<u>Event handler</u>	<u>Event handler event type</u>
<i>onenter</i>	

✓MDN

[TextTrackCue/onenter](#)

Support in all current engines.

[enter](#)

Firefox31+Safari6+Chrome23+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android31+Safari iOS7+Chrome Android25+WebView

Android37+Samsung Internet1.5+Opera Android12.1+

onexit

✓MDN

[TextTrackCue/onexit](#)

Support in all current engines.

[exit](#)

Firefox31+Safari6+Chrome23+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android31+Safari iOS7+Chrome Android25+WebView

Android37+Samsung Internet1.5+Opera Android12.1+

This section is non-normative.

Text tracks can be used for storing data relating to the media data, for interactive or augmented views.

For example, a page showing a sports broadcast could include information about the current score. Suppose a robotics competition was being streamed live. The image could be overlayed with the scores, as follows:



RED ALLIANCE
78

BLUE ALLIANCE
66

In order to make the score display render correctly whenever the user seeks to an arbitrary point in the video, the metadata text track cues need to be as long as is appropriate for the score. For example, in the frame above, there would be maybe one cue that lasts the length of the match that gives the match number, one cue that lasts until the blue alliance's score changes, and one cue that lasts until the red alliance's score changes. If the video is just a stream of the live event, the time in the bottom right would presumably be automatically derived from the current video time, rather than based on a cue. However, if the video was just the highlights, then that might be given in cues also.

The following shows what fragments of this could look like in a WebVTT file:

WEBVTT

...

```
05:10:00.000 --> 05:12:15.000
matchtype:qual
matchnumber:37
```

```
...
```

```
05:11:02.251 --> 05:11:17.198
red:78
```

```
05:11:03.672 --> 05:11:54.198
blue:66
```

```
05:11:17.198 --> 05:11:25.912
red:80
```

```
05:11:25.912 --> 05:11:26.522
red:83
```

```
05:11:26.522 --> 05:11:26.982
red:86
```

```
05:11:26.982 --> 05:11:27.499
red:89
```

```
...
```

The key here is to notice that the information is given in cues that span the length of time to which the relevant event applies. If, instead, the scores were given as zero-length (or very brief, nearly zero-length) cues when the score changes, for example saying "red+2" at 05:11:17.198, "red+3" at 05:11:25.912, etc, problems arise: primarily, seeking is much harder to implement, as the script has to walk the entire list of cues to make sure that no notifications have been missed; but also, if the cues are short it's possible the script will never see that they are active unless it listens to them specifically.

When using cues in this manner, authors are encouraged to use the [cuechange](#) event to update the current annotations. (In particular, using the [timeupdate](#) event would be less appropriate as it would require doing work even when the cues haven't changed, and, more importantly, would introduce a higher latency between when the metadata cues become active and when the display is updated, since [timeupdate](#) events are rate-limited.)

4.8.12.12 Identifying a track kind through a URL

Other specifications or formats that need a [URL](#) to identify the return values of the [AudioTrack kind](#) or [VideoTrack kind](#) IDL attributes, or identify the [kind of text track](#), must use the [about:html-kind URL](#).

4.8.12.13 User interface

The **controls** attribute is a [boolean attribute](#). If present, it indicates that the author has not provided a scripted controller and would like the user agent to provide its own set of controls.

If the attribute is present, or if [scripting is disabled](#) for the [media element](#), then the user agent should *expose a user interface to the user*. This user interface should include features to begin playback, pause playback, seek to an arbitrary position in the content (if the content supports arbitrary seeking), change the volume, change the display of closed captions or embedded sign-language tracks, select different audio tracks or turn on audio descriptions, and show the media content in manners more suitable to the user (e.g. fullscreen video or in an independent resizable window). Other controls may also be made available.

Even when the attribute is absent, however, user agents may provide controls to affect playback of the media resource (e.g. play, pause, seeking, track selection, and volume controls), but such features should not interfere with the page's normal rendering. For example, such features could be exposed in the [media element](#)'s context menu, platform media keys, or a remote control. The user agent may implement this simply by [exposing a user interface to the user](#) as described above (as if the **controls** attribute was present).

If the user agent [exposes a user interface to the user](#) by displaying controls over the [media element](#), then the user agent should suppress any user interaction events while the user agent is interacting with this interface. (For example, if the user clicks on a video's playback control, [mousedown](#) events and so forth would not simultaneously be fired at elements on the page.)

Where possible (specifically, for starting, stopping, pausing, and unpauseing playback, for seeking, for changing the rate of playback, for fast-forwarding or rewinding, for listing, enabling, and disabling text tracks, and for muting or changing the volume of the audio), user interface features exposed by the user agent must be implemented in terms of the DOM API described above, so that, e.g., all the same events fire.

Features such as fast-forward or rewind must be implemented by only changing the **playbackRate** attribute (and not the **defaultPlaybackRate** attribute).

Seeking must be implemented in terms of [seeking](#) to the requested position in the [media element](#)'s [media timeline](#). For media resources where seeking to an arbitrary position would be slow, user agents are encouraged to use the *approximate-for-speed* flag when seeking in response to the user manipulating an approximate position interface such as a seek bar.



[HTMLMediaElement/controls](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

The **controls** IDL attribute must [reflect](#) the content attribute of the same name.

`media.volume [= value]`

✓MDN

[HTMLMediaElement/volume](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns the current playback volume, as a number in the range 0.0 to 1.0, where 0.0 is the quietest and 1.0 the loudest.

Can be set, to change the volume.

Throws an ["IndexSizeError" DOMException](#) if the new value is not in the range 0.0 .. 1.0.

`media.muted [= value]`

✓MDN

[HTMLMediaElement/muted](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns true if audio is muted, overriding the [volume](#) attribute, and false if the [volume](#) attribute is being honored.

Can be set, to change whether the audio is muted or not.

A [media element](#) has a *playback volume*, which is a fraction in the range 0.0 (silent) to 1.0

(loudest). Initially, the volume should be 1.0, but user agents may remember the last set value across sessions, on a per-site basis or otherwise, so the volume may start at other values.

The **volume** IDL attribute must return the [playback volume](#) of any audio portions of the [media element](#). On setting, if the new value is in the range 0.0 to 1.0 inclusive, the [media element's playback volume](#) must be set to the new value. If the new value is outside the range 0.0 to 1.0 inclusive, then, on setting, an "[IndexSizeError](#)" [DOMException](#) must be thrown instead.

A [media element](#) can also be *muted*. If anything is muting the element, then it is muted. (For example, when the [direction of playback](#) is backwards, the element is muted.)

The **muted** IDL attribute must return the value to which it was last set. When a [media element](#) is created, if the element has a **muted** content attribute specified, then the **muted** IDL attribute should be set to true; otherwise, the user agents may set the value to the user's preferred value (e.g. remembering the last set value across sessions, on a per-site basis or otherwise). While the **muted** IDL attribute is set to true, the [media element](#) must be [muted](#).

Whenever either of the values that would be returned by the **volume** and **muted** IDL attributes change, the user agent must [queue a media element task](#) given the [media element](#) to [fire an event](#) named [volumechange](#) at the [media element](#). Then, if the [media element](#) is not [allowed to play](#), the user agent must run the [internal pause steps](#) for the [media element](#).

An element's *effective media volume* is determined as follows:

1. If the user has indicated that the user agent is to override the volume of the element, then return the volume desired by the user.
2. If the element's audio output is [muted](#), then return zero.
3. Let *volume* be the [playback volume](#) of the audio portions of the [media element](#), in range 0.0 (silent) to 1.0 (loudest).
4. Return *volume*, interpreted relative to the range 0.0 to 1.0, with 0.0 being silent, and 1.0 being the loudest setting, values in between increasing in loudness. The range need not be linear. The loudest setting may be lower than the system's loudest possible setting; for example the user could have set a maximum volume.

The **muted** content attribute on [media elements](#) is a [boolean attribute](#) that controls the default state of the audio output of the [media resource](#), potentially overriding user preferences.



[HTMLMediaElement/defaultMuted](#)

Support in all current engines.

Firefox 11 + Safari 6 + Chrome 15 +

Opera 12.1 + Edge 79 +

Edge (Legacy) 12 + Internet Explorer No

Firefox Android 14 + Safari iOS 6 + Chrome Android 18 + WebView Android 37 + Samsung Internet 1.0 + Opera Android 12.1 +

The **defaultMuted** IDL attribute must [reflect](#) the [muted](#) content attribute.

This attribute has no dynamic effect (it only controls the default state of the element).

This video (an advertisement) autoplays, but to avoid annoying users, it does so without sound, and allows the user to turn the sound on. The user agent can pause the video if it's unmuted without a user interaction.

```
<video src="adverts.cgi?kind=video" controls autoplay loop muted></video>
```

4.8.12.14 Time ranges

✓MDN

[TimeRanges](#)

Support in all current engines.

Firefox 4 + Safari 3.1 + Chrome 6 +

Opera 12.1 + Edge 79 +

Edge (Legacy) 12 + Internet Explorer 9 +

Firefox Android 4 + Safari iOS 2 + Chrome Android 18 + WebView Android 37 + Samsung Internet 1.0 + Opera Android 12.1 +

Objects implementing the [TimeRanges](#) interface represent a list of ranges (periods) of time.

```
[Exposed=Window]  
interface TimeRanges {  
    readonly attribute unsigned long length;  
    double start(unsigned long index);  
    double end(unsigned long index);  
};
```

[media.length](#)

✓MDN

[TimeRanges/length](#)

Support in all current engines.

Firefox4+Safari3.1+Chrome6+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns the number of ranges in the object.

`time = media.start(index)`

✓MDN

[TimeRanges/start](#)

Support in all current engines.

Firefox4+Safari3.1+Chrome6+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns the time for the start of the range with the given index.

Throws an ["IndexSizeError" DOMException](#) if the index is out of range.

`time = media.end(index)`

✓MDN

[TimeRanges/end](#)

Support in all current engines.

Firefox4+Safari3.1+Chrome6+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns the time for the end of the range with the given index.

Throws an ["IndexSizeError" DOMException](#) if the index is out of range.

The `length` IDL attribute must return the number of ranges represented by the object.

The `start(index)` method must return the position of the start of the `index`th range represented by the object, in seconds measured from the start of the timeline that the object

covers.

The `end(index)` method must return the position of the end of the `index`th range represented by the object, in seconds measured from the start of the timeline that the object covers.

These methods must throw "[IndexSizeError](#)" [DOMException](#)s if called with an `index` argument greater than or equal to the number of ranges represented by the object.

When a [TimeRanges](#) object is said to be a *normalized TimeRanges object*, the ranges it represents must obey the following criteria:

- The start of a range must be greater than the end of all earlier ranges.
- The start of a range must be less than or equal to the end of that same range.

In other words, the ranges in such an object are ordered, don't overlap, and don't touch (adjacent ranges are folded into one bigger range). A range can be empty (referencing just a single moment in time), e.g. to indicate that only one frame is currently buffered in the case that the user agent has discarded the entire [media resource](#) except for the current frame, when a [media element](#) is paused.

Ranges in a [TimeRanges](#) object must be inclusive.

Thus, the end of a range would be equal to the start of a following adjacent (touching but not overlapping) range. Similarly, a range covering a whole timeline anchored at zero would have a start equal to zero and an end equal to the duration of the timeline.

The timelines used by the objects returned by the [buffered](#), [seekable](#) and [played](#) IDL attributes of [media elements](#) must be that element's [media timeline](#).

4.8.12.15 The [TrackEvent](#) interface



[TrackEvent](#)

Support in all current engines.

Firefox 31+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Exposed=Window]

```
interface TrackEvent : Event {  
    constructor(DOMString type, optional TrackEventInit eventInitDict = {});
```

```
readonly attribute (VideoTrack or AudioTrack or TextTrack)? track;
```

```
};  
  
dictionary TrackEventInit : EventInit {  
  (VideoTrack or AudioTrack or TextTrack)? track = null;  
};
```

[event.track](#)



[TrackEvent/track](#)

Support in all current engines.

Firefox 31+ Safari Yes Chrome Yes

Opera? Edge Yes

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 31+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android?

Returns the track object ([TextTrack](#), [AudioTrack](#), or [VideoTrack](#)) to which the event relates.

The **track** attribute must return the value it was initialized to. It represents the context information for the event.

4.8.12.16 Events summary

This section is non-normative.

The following events fire on [media elements](#) as part of the processing model described above:

Event name	Interface	Fired when...	Preconditions
loadstart			
HTMLMediaElement/loadstart_event	Event	The user agent begins looking for media data , as networkState equals part of the resource selection algorithm .	NETWORK_LOADING
Support in all current engines.			
Firefox 6+ Safari 4+ Chrome 1+			
Opera 12.1+ Edge 79+			
Edge (Legacy) 12+ Internet Explorer 9+			

Event name	Interface	Fired when...	Preconditions
Firefox Android6+Safari iOS3+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+ <i>progress</i>			
	✓MDN		
HTMLMediaElement/ progress_event			
Support in all current engines.			
Firefox6+Safari1.3+Chrome1+ Opera12.1+Edge79+	Event	The user agent is fetching <code>networkState</code> equals <code>NETWORK_LOADING</code> media data.	
Edge (Legacy)12+Internet Explorer9+			
Firefox Android6+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+ <i>suspend</i>			
	✓MDN		
HTMLMediaElement/ suspend_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+	Event	The user agent is intentionally not currently fetching <code>media</code> data. <code>networkState</code> equals <code>NETWORK_IDLE</code>	
Edge (Legacy)12+Internet Explorer9+			
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+			
<i>abort</i>	Event	The user agent stops fetching the <code>media data</code> before it is completely	<code>error</code> is an object with the code <code>MEDIA_ERR_ABORTED</code> .
	✓MDN		

Event name	Interface	Fired when...	Preconditions
HTMLMediaElement/abort_event			
Support in all current engines.			
Firefox9+Safari1.3+Chrome1+ Opera12.1+Edge79+ Edge (Legacy)12+Internet Explorer9+		downloaded, but not due to an error.	<code>networkState</code> equals either <code>NETWORK_EMPTY</code> or <code>NETWORK_IDLE</code> , depending on when the download was aborted.
Firefox Android9+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+ <i>error</i>			
 MDN			
HTMLMediaElement/error_event			
Support in all current engines.			
Firefox6+Safari1.3+Chrome1+ Opera11.6+Edge79+ Edge (Legacy)12+Internet Explorer9+	Event	An error occurs while fetching the <code>media data</code> or the type of the resource is not supported media format.	<code>error</code> is an object with the code <code>MEDIA_ERR_NETWORK</code> or higher. <code>networkState</code> equals either <code>NETWORK_EMPTY</code> or <code>NETWORK_IDLE</code> , depending on when the download was aborted.
Firefox Android6+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12+ <i>emptied</i>			
 MDN			
HTMLMediaElement/emptied_event	Event	A <code>media element</code> whose <code>networkState</code> was previously not in the <code>NETWORK_EMPTY</code> state has just switched to that state (either because of a fatal error during load that's about to be reported, or because the <code>load()</code> method was invoked while the <code>resource selection</code>	<code>networkState</code> is <code>NETWORK_EMPTY</code> ; all the IDL attributes are in their initial states.
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+			

Event name	Interface	Fired when...	Preconditions
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+ <i>stalled</i>		<u>algorithm</u> was already running).	
	✓MDN		
HTMLMediaElement/ stalled_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ <u>Event</u> Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+		The user agent is trying to fetch <u>media data</u> , but data is unexpectedly not forthcoming.	<u>networkState</u> is <u>NETWORK_LOADING</u> .
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+ <i>loadedmetadata</i>			
	✓MDN		
HTMLMediaElement/ loadedmetadata_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ <u>Event</u> Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+		The user agent has just determined the duration and dimensions of the <u>media resource</u> and <u>the text tracks are ready</u> .	<u>readyState</u> is newly equal to <u>HAVE_METADATA</u> or greater for the first time
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+ <i>loadeddata</i>			
	✓MDN		
HTMLMediaElement/ loadeddata_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ <u>Event</u> Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+		The user agent can render the <u>media data</u> at the <u>current playback position</u> for the first time.	<u>readyState</u> newly increased to <u>HAVE_CURRENT_DATA</u> or greater for the first time.
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+ <i>loadeddata</i>			
	✓MDN		
HTMLMediaElement/ loadeddata_event			

Event name	Interface	Fired when...	Preconditions
loadeddata_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+			
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+			
<i>canplay</i>			
 MDN			
HTMLMediaElement/ canplay_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+	Event		
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+			
<i>canplaythrough</i>			
 MDN			
HTMLMediaElement/ canplaythrough_event			
Support in all current engines.	Event		
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+			
Firefox Android4+Safari			
		The user agent can resume playback of the media data , but estimates that if playback were to be started now, the media resource could not be rendered at the current playback rate up to its end without having to stop for further buffering of content.	readyState newly increased to HAVE_FUTURE_DATA or greater.
		The user agent estimates that if playback were to be started now, the media resource could be rendered at the current playback rate all the way to its end without having to stop for further buffering.	readyState is newly equal to HAVE_ENOUGH_DATA .

Event name	Interface	Fired when...	Preconditions
iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+ <i>playing</i>			readyState is newly equal to or greater than HAVE_FUTURE_DATA and paused is false, or paused is newly false and readyState is
HTMLMediaElement/playing_event			readyState is newly equal to or greater than HAVE_FUTURE_DATA . Even if this event fires, the element might still not be potentially playing , e.g. if the element is paused for user interaction or paused for in-band content .
Support in all current engines.		Playback is ready to start after having been paused or delayed due to lack of media data .	
Firefox3.5+Safari3.1+Chrome3+ Event Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+ Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+			readyState is equal to or less than HAVE_CURRENT_DATA , and paused is false. Either seeking is true, or the current playback position is not contained in any of the ranges in buffered . It is possible for playback to stop for other reasons without paused being false, but those reasons do not fire this event (and when those situations resolve, a separate playing event is not fired either): e.g., playback has ended , or playback stopped due to errors , or the element has paused for user interaction or paused for in-band content .
<i>waiting</i>			
HTMLMediaElement/waiting_event			
Support in all current engines.		Playback has stopped because the next frame is not available, but the user agent expects that frame to become available in due course.	
Firefox6+Safari4+Chrome1+ Event Opera12.1+Edge79+ Edge (Legacy)12+Internet Explorer9+ Firefox Android6+Safari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+			

Event name	Interface	Fired when...	Preconditions
<i>seeking</i>			
	✓MDN		
HTMLMediaElement/ seeking_event			
Support in all current engines.		The seeking IDL attribute changed to true, and the user agent has started seeking to a new position.	
Firefox3.5+Safari3.1+Chrome3+ Event			
Opera10.5+Edge79+			
Edge (Legacy)12+Internet			
Explorer9+			
Firefox Android4+Safari			
iOS2+Chrome			
Android18+WebView			
Android37+Samsung			
Internet1.0+Opera Android11+			
<i>seeked</i>			
	✓MDN		
HTMLMediaElement/ seeked_event			
Support in all current engines.		The seeking IDL attribute changed to false after the current playback position was changed.	
Firefox3.5+Safari3.1+Chrome3+ Event			
Opera10.5+Edge79+			
Edge (Legacy)12+Internet			
Explorer9+			
Firefox Android4+Safari			
iOS2+Chrome			
Android18+WebView			
Android37+Samsung			
Internet1.0+Opera Android11+			
<i>ended</i>			
	✓MDN		
HTMLMediaElement/ ended_event	Event	Playback has stopped because the end of the media resource was reached.	currentTime equals the end of the media resource ; ended is true.
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+			
Opera10.5+Edge79+			

Event name	Interface	Fired when...	Preconditions
Edge (Legacy)12+Internet Explorer9+			
Firefox Android4+Safari iOS2+Chrome			
Android18+WebView			
Android37+Samsung			
Internet1.0+Opera Android11+ <i>durationchange</i>			
 MDN			

[HTMLMediaElement/durationchange_event](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome3+ Event	The duration attribute has just been updated.
Opera10.5+Edge79+	

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS2+Chrome
Android18+WebView
Android37+Samsung
Internet1.0+Opera Android11+ <i>timeupdate</i>



[HTMLMediaElement/timeupdate_event](#)

Support in all current engines.

The [current playback position](#) changed as part of normal playback or in an especially interesting way, for example discontinuously.

Firefox3.5+Safari3.1+Chrome3+ Event
Opera10.5+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS2+Chrome
Android18+WebView
Android37+Samsung
Internet1.0+Opera Android11+ <i>play</i>



[Event](#)

The element is no longer paused. Fired after the [play\(\)](#) method has [paused](#) is newly false.

Event name	Interface	Fired when...	Preconditions
HTMLMediaElement/play_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+		returned, or when the autoplay attribute has caused playback to begin.	
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+ <i>pause</i>			
 MDN			
HTMLMediaElement/pause_event			
Support in all current engines.			
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+	Event	The element has been paused. Fired after the pause() method has returned.	paused is newly true.
Firefox Android4+Safari iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+ <i>ratechange</i>			
 MDN			
HTMLMediaElement/ratechange_event			
Support in all current engines.	Event		
Firefox3.5+Safari3.1+Chrome3+ Opera10.5+Edge79+ Edge (Legacy)12+Internet Explorer9+		Either the defaultPlaybackRate or the playbackRate attribute has just been updated.	
Firefox Android4+Safari			

Event name	Interface	Fired when...	Preconditions
iOS2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera	Android11+		
resize	Event	One or both of the <code>videoWidth</code> and <code>videoHeight</code> attributes have just been updated.	Media element is a <code>video</code> element; readyState is not HAVE NOTHING
volumechange			
			
HTMLMediaElement/volumechange_event			
Support in all current engines.			
Firefox6+Safari4+Chrome1+	Event		
Opera12.1+Edge79+			
Edge (Legacy)12+Internet Explorer9+			
Firefox Android6+Safari			
iOS3+Chrome			
Android18+WebView			
Android37+Samsung			
Internet1.0+Opera			
Android12.1+			

The following event fires on [source](#) element:

Event name	Interface	Fired when...
error	Event	An error occurs while fetching the media data or the type of the resource is not supported media format.

The following events fire on [AudioTrackList](#), [VideoTrackList](#), and [TextTrackList](#) objects:

Event name	Interface	Fired when...
change	Event	One or more tracks in the track list have been enabled or disabled.
AudioTrackList/change_event		

Event name	Interface	Fired when...
Support in all current engines.		
Firefox 33+ Safari 7+ Chrome 37+		
Opera 24+ Edge 79+		
Edge (Legacy) No Internet Explorer 10+		
Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+		

[TextTrackList/change_event](#)

Support in all current engines.

Firefox 31+ Safari 7+ Chrome 33+		
Opera 20+ Edge 79+		
Edge (Legacy) 18 Internet Explorer No		
Firefox Android 31+ Safari iOS 7+ Chrome Android 33+ WebView Android 4.4.3+ Samsung Internet 2.0+ Opera Android 20+		

[VideoTrackList/change_event](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+		
Opera 24+ Edge 79+		
Edge (Legacy) No Internet Explorer 10+		
Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+		

addtrack

 MDN

[AudioTrackList/addtrack_event](#)

Support in all current engines.

Firefox 33+ Safari 7+ Chrome 37+	TrackEvent	A track has been added to the track list.
Opera 24+ Edge 79+		
Edge (Legacy) No Internet Explorer 10+		
Firefox Android 33+ Safari iOS 7+ Chrome Android 37+ WebView Android No Samsung Internet No Opera Android 24+		

Event name	Interface	Fired when...
TextTrackList/addtrack_event		
Support in all current engines.		
Firefox31+Safari6+Chrome23+ Opera12.1+Edge79+ Edge (Legacy)12+Internet Explorer11 Firefox Android31+Safari iOS7+Chrome Android25+WebView Android37+Samsung Internet1.5+Opera Android12.1+		
VideoTrackList/addtrack_event		
Support in all current engines.		
Firefox 33+Safari7+Chrome 37+ Opera 24+Edge 79+ Edge (Legacy)NoInternet Explorer10+ Firefox Android 33+Safari iOS7+Chrome Android 37+WebView AndroidNoSamsung InternetNoOpera Android 24+ <i>removetrack</i>		
 MDN		
AudioTrackList/removetrack_event		
Support in all current engines.		
Firefox 33+Safari7+Chrome 37+ Opera 24+Edge 79+ Edge (Legacy)NoInternet Explorer10+ Firefox Android 33+Safari iOS7+Chrome Android 37+WebView AndroidNoSamsung InternetNoOpera Android 24+		TrackEvent A track has been removed from the track list.
TextTrackList/removetrack_event		
Support in all current engines.		
Firefox31+Safari7+Chrome33+ Opera20+Edge79+ Edge (Legacy)18Internet ExplorerNo Firefox Android31+Safari iOS7+Chrome		

Event name	Interface	Fired when...
Android33+WebView Android4.4.3+Samsung Internet2.0+Opera Android20+		

[VideoTrackList/removetrack_event](#)

Support in all current engines.

Firefox 33+Safari 7+Chrome 37+

Opera 24+Edge 79+

Edge (Legacy)NoInternet Explorer 10+

Firefox Android 33+Safari iOS 7+Chrome

Android 37+WebView Android NoSamsung

Internet NoOpera Android 24+

The following event fires on [TextTrack](#) objects and [track](#) elements:

Event name	Interface	Fired when...
<i>cuechange</i>		

✓MDN

[HTMLTrackElement/cuechange_event](#)

Support in all current engines.

Firefox 68+Safari 7+Chrome 23+

Opera 15+Edge 79+

Edge (Legacy)NoInternet Explorer No

Firefox Android 68+Safari iOS 7+Chrome

Android 25+WebView Android 37+Samsung

Internet 1.5+Opera Android 14+

[Event](#)

One or more cues in the track have become active or stopped being active.

[TextTrack/cuechange_event](#)

Support in all current engines.

Firefox 31+Safari 7+Chrome 23+

Opera 15+Edge 79+

Edge (Legacy) 12+Internet Explorer 10+

Firefox Android 31+Safari iOS 7+Chrome

Android 25+WebView Android 37+Samsung

Internet 1.5+Opera Android 14+

The following events fire on [track](#) elements:

Event name	Interface	Fired when...
error	Event	An error occurs while fetching the track data or the type of the resource is not supported text track format.
load	Event	A track data has been fetched and successfully processed.

The following events fire on [TextTrackCue](#) objects:

Event name	Interface	Fired when...
enter	Event	The cue has become active.
exit	Event	The cue has stopped being active.

4.8.12.17 Security and privacy considerations

The main security and privacy implications of the [video](#) and [audio](#) elements come from the ability to embed media cross-origin. There are two directions that threats can flow: from hostile content to a victim page, and from a hostile page to victim content.

If a victim page embeds hostile content, the threat is that the content might contain scripted code that attempts to interact with the [Document](#) that embeds the content. To avoid this, user agents must ensure that there is no access from the content to the embedding page. In the case of media content that uses DOM concepts, the embedded content must be treated as if it was in its own unrelated [top-level browsing context](#).

For instance, if an SVG animation was embedded in a [video](#) element, the user agent would not give it access to the DOM of the outer page. From the perspective of scripts in the SVG resource, the SVG file would appear to be in a lone top-level browsing context with no parent.

If a hostile page embeds victim content, the threat is that the embedding page could obtain information from the content that it would not otherwise have access to. The API does expose some information: the existence of the media, its type, its duration, its size, and the performance characteristics of its host. Such information is already potentially problematic, but in practice the same information can more or less be obtained using the [img](#) element, and so it has been deemed acceptable.

However, significantly more sensitive information could be obtained if the user agent further exposes metadata within the content, such as subtitles. That information is therefore only exposed if the video resource uses CORS. The [crossorigin](#) attribute allows authors to enable CORS. [\[FETCH\]](#)

Without this restriction, an attacker could trick a user running within a corporate network into visiting a site that attempts to load a video from a previously leaked location on the corporation's intranet. If such a video included confidential plans for a new product, then being able to read the subtitles would present a serious confidentiality breach.

4.8.12.18 Best practices for authors using media elements

This section is non-normative.

Playing audio and video resources on small devices such as set-top boxes or mobile phones is often constrained by limited hardware resources in the device. For example, a device might only support three simultaneous videos. For this reason, it is a good practice to release resources held by [media elements](#) when they are done playing, either by being very careful about removing all references to the element and allowing it to be garbage collected, or, even better, by setting the element's [src](#) attribute to an empty string. In cases where [srcObject](#) was set, instead set the [srcObject](#) to null.

Similarly, when the playback rate is not exactly 1.0, hardware, software, or format limitations can cause video frames to be dropped and audio to be choppy or muted.

4.8.12.19 Best practices for implementers of media elements

This section is non-normative.

How accurately various aspects of the [media element](#) API are implemented is considered a quality-of-implementation issue.

For example, when implementing the [buffered](#) attribute, how precise an implementation reports the ranges that have been buffered depends on how carefully the user agent inspects the data. Since the API reports ranges as times, but the data is obtained in byte streams, a user agent receiving a variable-bitrate stream might only be able to determine precise times by actually decoding all of the data. User agents aren't required to do this, however; they can instead return estimates (e.g. based on the average bitrate seen so far) which get revised as more information becomes available.

As a general rule, user agents are urged to be conservative rather than optimistic. For example, it would be bad to report that everything had been buffered when it had not.

Another quality-of-implementation issue would be playing a video backwards when the codec is designed only for forward playback (e.g. there aren't many key frames, and they are far apart, and the intervening frames only have deltas from the previous frame). User agents could do a poor job, e.g. only showing key frames; however, better implementations would do more work and thus do a better job, e.g. actually decoding parts of the video forwards, storing the complete frames, and then playing the frames backwards.

Similarly, while implementations are allowed to drop buffered data at any time (there is no requirement that a user agent keep all the media data obtained for the lifetime of the media element), it is again a quality of implementation issue: user agents with sufficient resources to keep all the data around are encouraged to do so, as this allows for a better user experience. For example, if the user is watching a live stream, a user agent could allow the user only to view the live video; however, a better user agent would buffer everything and allow the user to seek through the earlier material, pause it, play it forwards and backwards, etc.

When a [media element](#) that is paused is [removed from a document](#) and not reinserted before the next time the [event loop](#) reaches [step 1](#), implementations that are resource constrained are encouraged to take that opportunity to release all hardware resources (like video planes, networking resources, and data buffers) used by the [media element](#). (User agents still have to keep track of the playback position and so forth, though, in case playback is later restarted.)

4.8.13 The **map** element



[Element/map](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android Yes



[HTMLMapElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [phrasing content](#) is expected.

Content model:

[Transparent](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

Content attributes:

Global attributes

name — Name of image map to reference from the usemap attribute

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLMapElement : HTMLElement {
  [HTMLConstructor] constructor();
  [CEReactions] attribute DOMString name;
  [SameObject] readonly attribute HTMLCollection areas;
};
```

The map element, in conjunction with an img element and any area element descendants, defines an image map. The element represents its children.

The name attribute gives the map a name so that it can be referenced. The attribute must be present and must have a non-empty value with no ASCII whitespace. The value of the name attribute must not be equal to the value of the name attribute of another map element in the same tree. If the id attribute is also specified, both attributes must have the same value.

map.areas

Returns an HTMLCollection of the area elements in the map.

The areas attribute must return an HTMLCollection rooted at the map element, whose filter matches only area elements.

The IDL attribute name must reflect the content attribute of the same name.

Image maps can be defined in conjunction with other content on the page, to ease maintenance. This example is of a page with an image map at the top of the page and a corresponding set of text links at the bottom.

```
<!DOCTYPE HTML>
<HTML LANG="EN">
<TITLE>Babies™: Toys</TITLE>
<HEADER>
  <H1>Toys</H1>
  <IMG SRC="/images/menu.gif"
    ALT="Babies™ navigation menu. Select a department to go to its page.">
```

```

    USEMAP="#NAV">
</HEADER>
...
<FOOTER>
<MAP NAME="NAV">
<P>
<A HREF="/clothes/">Clothes</A>
<AREA ALT="Clothes" COORDS="0,0,100,50" HREF="/clothes/"> |
<A HREF="/toys/">Toys</A>
<AREA ALT="Toys" COORDS="100,0,200,50" HREF="/toys/"> |
<A HREF="/food/">Food</A>
<AREA ALT="Food" COORDS="200,0,300,50" HREF="/food/"> |
<A HREF="/books/">Books</A>
<AREA ALT="Books" COORDS="300,0,400,50" HREF="/books/">
</P>
</MAP>
</FOOTER>
```

4.8.14 The **area** element



[Element/area](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLAreaElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content.](#)

[Phrasing content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected, but only if there is a [map](#) element ancestor.

Content model:

[Nothing.](#)

Tag omission in text/html:

No [end tag](#).

Content attributes:

[Global attributes](#)

[**alt**](#) — Replacement text for use when images are not available

[**coords**](#) — Coordinates for the shape to be created in an [image map](#)

[**shape**](#) — The kind of shape to be created in an [image map](#)

[**href**](#) — Address of the [hyperlink](#)

[**target**](#) — [Browsing context](#) for [hyperlink navigation](#)

[**download**](#) — Whether to download the resource instead of navigating to it, and its filename if so

[**ping**](#) — [URLs](#) to ping

[**rel**](#) — Relationship between the location in the document containing the [hyperlink](#) and the destination resource

[**referrerpolicy**](#) — [Referrer policy](#) for [fetches](#) initiated by the element

Accessibility considerations:

If the element has an [**href**](#) attribute: [for authors](#); [for implementers](#).

Otherwise: [for authors](#); [for implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLAreaElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute DOMString alt;
  [CEReactions] attribute DOMString coords;
  [CEReactions] attribute DOMString shape;
  [CEReactions] attribute DOMString target;
  [CEReactions] attribute DOMString download;
  [CEReactions] attribute USVString ping;
```

```

[CEReactions] attribute DOMString rel;
[SameObject, PutForwards=value] readonly attribute DOMTokenList relList;
[CEReactions] attribute DOMString referrerPolicy;

// also has obsolete members
};

HTMLAreaElement includes HTMLHyperlinkElementUtils;

```

The [area](#) element [represents](#) either a hyperlink with some text and a corresponding area on an [image map](#), or a dead area on an image map.

An [area](#) element with a parent node must have a [map](#) element ancestor.

If the [area](#) element has an [href](#) attribute, then the [area](#) element represents a [hyperlink](#). In this case, the [alt](#) attribute must be present. It specifies the text of the hyperlink. Its value must be text that, when presented with the texts specified for the other hyperlinks of the [image map](#), and with the alternative text of the image, but without the image itself, provides the user with the same kind of choice as the hyperlink would when used without its text but with its shape applied to the image. The [alt](#) attribute may be left blank if there is another [area](#) element in the same [image map](#) that points to the same resource and has a non-blank [alt](#) attribute.

If the [area](#) element has no [href](#) attribute, then the area represented by the element cannot be selected, and the [alt](#) attribute must be omitted.

In both cases, the [shape](#) and [coords](#) attributes specify the area.

The [shape](#) attribute is an [enumerated attribute](#). The following table lists the keywords defined for this attribute. The states given in the first cell of the rows with keywords give the states to which those keywords map. Some of the keywords are non-conforming, as noted in the last column.

State	Keywords	Notes
Circle state	circle	
	circ	Non-conforming
Default state	default	
Polygon state	poly	
	polygon	Non-conforming
Rectangle state	rect	
	rectangle	Non-conforming

The attribute may be omitted. The [missing value default](#) and [invalid value default](#) are the [rectangle](#) state.

The [coords](#) attribute must, if specified, contain a [valid list of floating-point numbers](#). This attribute gives the coordinates for the shape described by the [shape](#) attribute. The processing for this attribute is described as part of the [image map](#) processing model.

In the *circle state*, [area](#) elements must have a [coords](#) attribute present, with three integers, the last of which must be non-negative. The first integer must be the distance in [CSS pixels](#) from the left edge of the image to the center of the circle, the second integer must be the distance in [CSS pixels](#) from the top edge of the image to the center of the circle, and the third integer must be the radius of the circle, again in [CSS pixels](#).

In the *default state* state, [area](#) elements must not have a [coords](#) attribute. (The area is the whole image.)

In the *polygon state*, [area](#) elements must have a [coords](#) attribute with at least six integers, and the number of integers must be even. Each pair of integers must represent a coordinate given as the distances from the left and the top of the image in [CSS pixels](#) respectively, and all the coordinates together must represent the points of the polygon, in order.

In the *rectangle state*, [area](#) elements must have a [coords](#) attribute with exactly four integers, the first of which must be less than the third, and the second of which must be less than the fourth. The four points must represent, respectively, the distance from the left edge of the image to the left side of the rectangle, the distance from the top edge to the top side, the distance from the left edge to the right side, and the distance from the top edge to the bottom side, all in [CSS pixels](#).

When user agents allow users to [follow hyperlinks](#) or [download hyperlinks](#) created using the [area](#) element, as described in the next section, the [href](#), [target](#), [download](#), and [ping](#) attributes decide how the link is followed. The [rel](#) attribute may be used to indicate to the user the likely nature of the target resource before the user follows the link.

The [target](#), [download](#), [ping](#), [rel](#), and [referrerpolicy](#) attributes must be omitted if the [href](#) attribute is not present.

If the [itemprop](#) attribute is specified on an [area](#) element, then the [href](#) attribute must also be specified.

The [activation behavior](#) of an [area](#) element is:

1. If *element* has no [href](#) attribute, then return.
2. If *element* has a [download](#) attribute, or if the user has expressed a preference to download the hyperlink, then [download the hyperlink](#) created by *element*.
3. Otherwise, [follow the hyperlink](#) created by *element*.



[HTMLAreaElement/rel](#)

Support in all current engines.

Firefox30+Safari9+Chrome54+

Opera41+Edge79+

Edge (Legacy)12+Internet Explorer11

Firefox Android30+Safari iOS9+Chrome Android54+WebView Android54+Samsung Internet6.0+Opera Android41+

The IDL attributes *alt*, *coords*, *target*, *download*, *ping*, and *rel*, each must [reflect](#) the respective content attributes of the same name.

The IDL attribute *shape* must [reflect](#) the [*shape*](#) content attribute.



[HTMLAreaElement/reList](#)

Support in all current engines.

Firefox30+Safari9+Chrome65+

Opera41+Edge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android30+Safari iOS9+Chrome Android65+WebView Android65+Samsung Internet9.0+Opera Android41+

The IDL attribute *reList* must [reflect](#) the [*rel*](#) content attribute.



[HTMLAreaElement/referrerPolicy](#)

Support in all current engines.

Firefox50+Safari14.1+Chrome53+

Opera40+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android50+Safari iOS14.5+Chrome Android53+WebView Android53+Samsung Internet7.2+Opera Android41+

The IDL attribute *referrerPolicy* must [reflect](#) the [*referrerpolicy*](#) content attribute, [limited to only known values](#).

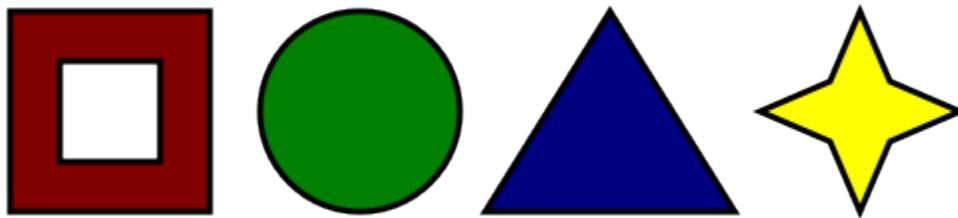
4.8.15 Image maps

4.8.15.1 Authoring

An *image map* allows geometric areas on an image to be associated with [hyperlinks](#).

An image, in the form of an `img` element, may be associated with an image map (in the form of a `map` element) by specifying a `usemap` attribute on the `img` element. The `usemap` attribute, if specified, must be a [valid hash-name reference](#) to a `map` element.

Consider an image that looks as follows:



If we wanted just the colored areas to be clickable, we could do it as follows:

```
<p>
  Please select a shape:
  
  <map name="shapes">
    <area shape=rect coords="50,50,100,100"> <!-- the hole in the red box -->
    <area shape=rect coords="25,25,125,125" href="red.html" alt="Red box.">
    <area shape=circle coords="200,75,50" href="green.html" alt="Green circle.">
    <area shape=poly coords="325,25,262,125,388,125" href="blue.html" alt="Blue triangle.">
    <area shape=poly coords="450,25,435,60,400,75,435,90,450,125,465,90,500,75,>
      href="yellow.html" alt="Yellow star.">
  </map>
</p>
```

4.8.15.2 Processing model

If an `img` element has a `usemap` attribute specified, user agents must process it as follows:

1. Parse the attribute's value using the [rules for parsing a hash-name reference](#) to a `map` element, with the element as the context node. This will return either an element (the `map`) or null.
2. If that returned null, then return. The image is not associated with an image map after all.
3. Otherwise, the user agent must collect all the `area` elements that are descendants of the `map`. Let those be the `areas`.

Having obtained the list of `area` elements that form the image map (the `areas`), interactive user agents must process the list in one of two ways.

If the user agent intends to show the text that the `img` element represents, then it must use the following steps.

1. Remove all the `area` elements in `areas` that have no `href` attribute.
2. Remove all the `area` elements in `areas` that have no `alt` attribute, or whose `alt` attribute's value is the empty string, *if* there is another `area` element in `areas` with the same value in the `href` attribute and with a non-empty `alt` attribute.
3. Each remaining `area` element in `areas` represents a [hyperlink](#). Those hyperlinks should all be made available to the user in a manner associated with the text of the `img`.

In this context, user agents may represent `area` and `img` elements with no specified `alt` attributes, or whose `alt` attributes are the empty string or some other non-visible text, in an [implementation-defined](#) fashion intended to indicate the lack of suitable author-provided text.

If the user agent intends to show the image and allow interaction with the image to select hyperlinks, then the image must be associated with a set of layered shapes, taken from the `area` elements in `areas`, in reverse [tree order](#) (so the last specified `area` element in the `map` is the bottom-most shape, and the first element in the `map`, in [tree order](#), is the top-most shape).

Each `area` element in `areas` must be processed as follows to obtain a shape to layer onto the image:

1. Find the state that the element's `shape` attribute represents.
2. Use the [rules for parsing a list of floating-point numbers](#) to parse the element's `coords` attribute, if it is present, and let the result be the `coords` list. If the attribute is absent, let the `coords` list be the empty list.
3. If the number of items in the `coords` list is less than the minimum number given for the `area` element's current state, as per the following table, then the shape is empty; return.

State	Minimum number of items
Circle state	3
Default state	0
Polygon state	6
Rectangle state	4

4. Check for excess items in the `coords` list as per the entry in the following list corresponding to the `shape` attribute's state:

[Circle state](#)

Drop any items in the list beyond the third.

Default state

Drop all items in the list.

Polygon state

Drop the last item if there's an odd number of items.

Rectangle state

Drop any items in the list beyond the fourth.

5. If the **shape** attribute represents the [rectangle state](#), and the first number in the list is numerically greater than the third number in the list, then swap those two numbers around.
6. If the **shape** attribute represents the [rectangle state](#), and the second number in the list is numerically greater than the fourth number in the list, then swap those two numbers around.
7. If the **shape** attribute represents the [circle state](#), and the third number in the list is less than or equal to zero, then the shape is empty; return.
8. Now, the shape represented by the element is the one described for the entry in the list below corresponding to the state of the **shape** attribute:

Circle state

Let x be the first number in $coords$, y be the second number, and r be the third number.

The shape is a circle whose center is x [CSS pixels](#) from the left edge of the image and y [CSS pixels](#) from the top edge of the image, and whose radius is r [CSS pixels](#).

Default state

The shape is a rectangle that exactly covers the entire image.

Polygon state

Let x_i be the $(2i)$ th entry in $coords$, and y_i be the $(2i+1)$ th entry in $coords$ (the first entry in $coords$ being the one with index 0).

Let *the coordinates* be (x_i, y_i) , interpreted in [CSS pixels](#) measured from the top left of the image, for all integer values of i from 0 to $(N/2)-1$, where N is the number of items in $coords$.

The shape is a polygon whose vertices are given by *the coordinates*, and whose interior is established using the even-odd rule. [\[GRAPHICS\]](#)

[Rectangle state](#)

Let x_1 be the first number in *coords*, y_1 be the second number, x_2 be the third number, and y_2 be the fourth number.

The shape is a rectangle whose top-left corner is given by the coordinate (x_1, y_1) and whose bottom right corner is given by the coordinate (x_2, y_2) , those coordinates being interpreted as [CSS pixels](#) from the top left corner of the image.

For historical reasons, the coordinates must be interpreted relative to the *displayed* image after any stretching caused by the CSS '[width](#)' and '[height](#)' properties (or, for non-CSS browsers, the image element's **width** and **height** attributes — CSS browsers map those attributes to the aforementioned CSS properties).

Browser zoom features and transforms applied using CSS or SVG do not affect the coordinates.

Pointing device interaction with an image associated with a set of layered shapes per the above algorithm must result in the relevant user interaction events being first fired to the top-most shape covering the point that the pointing device indicated, if any, or to the image element itself, if there is no shape covering that point. User agents may also allow individual [area](#) elements representing [hyperlinks](#) to be selected and activated (e.g. using a keyboard).

Because a [map](#) element (and its [area](#) elements) can be associated with multiple [img](#) elements, it is possible for an [area](#) element to correspond to multiple [focusable areas](#) of the document.

Image maps are [live](#); if the DOM is mutated, then the user agent must act as if it had rerun the algorithms for image maps.

4.8.16 MathML



[HTML/HTML5/HTML5_Parser#Inline_SVG_and_MathML_support](#)

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 7+

Opera 11.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 5+ Safari iOS 5+ Chrome Android 18+ WebView Android 3+ Samsung Internet 1.0+ Opera Android 12+

The [MathML **math**](#) element falls into the [embedded content](#), [phrasing content](#), [flow content](#), and [palpable content](#) categories for the purposes of the content models in this specification.

When the [MathML annotation-xml](#) element contains elements from the [HTML namespace](#), such elements must all be [flow content](#).

When the MathML token elements ([mi](#), [mo](#), [mn](#), [ms](#), and [mtext](#)) are descendants of HTML elements, they may contain [phrasing content](#) elements from the [HTML namespace](#).

User agents must handle text other than [inter-element whitespace](#) found in MathML elements whose content models do not allow straight text by pretending for the purposes of MathML content models, layout, and rendering that the text is actually wrapped in a [MathML mtext](#) element. (Such text is not, however, conforming.)

User agents must act as if any MathML element whose contents does not match the element's content model was replaced, for the purposes of MathML layout and rendering, by a [MathML merror](#) element containing some appropriate error message.

The semantics of MathML elements are defined by *MathML* and [other applicable specifications](#).
[\[MATHML\]](#)

Here is an example of the use of MathML in an HTML document:

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <title>The quadratic formula</title>
  </head>
  <body>
    <h1>The quadratic formula</h1>
    <p>
      <math>
        <mi>x</mi>
        <mo>=</mo>
        <mfrac>
          <mrow>
            <mo form="prefix">-</mo> <mi>b</mi>
            <mo>±</mo>
            <msqrt>
              <msup> <mi>b</mi> <mn>2</mn> </msup>
              <mo>-</mo>
              <mn>4</mn> <mo></mo> <mi>a</mi> <mo></mo> <mi>c</mi>
            </msqrt>
          </mrow>
          <mrow>
            <mn>2</mn> <mo></mo> <mi>a</mi>
          </mrow>
        </mfrac>
      </math>
    </p>
```

```
</body>
</html>
```

4.8.17 SVG

✓MDN

[HTML/HTML5/HTML5_Parser#Inline_SVG_and_MathML_support](#)

Support in all current engines.

Firefox 37+ Safari 11.1+ Chrome 7+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 37+ Safari iOS 11.3+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 4+ Opera Android 15+

The [SVG `svg`](#) element falls into the [embedded content](#), [phrasing content](#), [flow content](#), and [palpable content](#) categories for the purposes of the content models in this specification.

When the [SVG `foreignObject`](#) element contains elements from the [HTML namespace](#), such elements must all be [flow content](#).

The content model for the [SVG `title`](#) element inside [HTML documents](#) is [phrasing content](#). (This further constrains the requirements given in *SVG 2*.)

The semantics of SVG elements are defined by *SVG 2* and [other applicable specifications](#). [SVG]

```
doc = iframe.getSVGDocument()
doc = embed.getSVGDocument()
doc = object.getSVGDocument()
```

Returns the [Document](#) object, in the case of [iframe](#), [embed](#), or [object](#) elements being used to embed SVG.

The `getSVGDocument()` method must run the following steps:

1. Let *document* be this element's [content document](#).
2. If *document* is non-null and was created by the [page load processing model for XML files](#) section because the [computed type of the resource](#) in the [navigate](#) algorithm was [image/svg+xml](#), then return *document*.
3. Return null.

4.8.18 Dimension attributes

Author requirements: The `width` and `height` attributes on [img](#), [iframe](#), [embed](#), [object](#), [video](#), [source](#) when the parent is a [picture](#) element and, when their `type` attribute is in the [Image Button](#) state, [input](#) elements may be specified to give the dimensions of the visual content of the element (the width and height respectively, relative to the nominal direction of the output medium), in [CSS pixels](#). The attributes, if specified, must have values that are [valid non-negative integers](#).

The specified dimensions given may differ from the dimensions specified in the resource itself, since the resource may have a resolution that differs from the CSS pixel resolution. (On screens, [CSS pixels](#) have a resolution of 96ppi, but in general the CSS pixel resolution depends on the reading distance.) If both attributes are specified, then one of the following statements must be true:

- $\text{specified width} - 0.5 \leq \text{specified height} * \text{target ratio} \leq \text{specified width} + 0.5$
- $\text{specified height} - 0.5 \leq \text{specified width} / \text{target ratio} \leq \text{specified height} + 0.5$
- $\text{specified height} = \text{specified width} = 0$

The `target ratio` is the ratio of the [intrinsic width](#) to the [intrinsic height](#) in the resource. The `specified width` and `specified height` are the values of the [width](#) and [height](#) attributes respectively.

The two attributes must be omitted if the resource in question does not have both an [intrinsic width](#) and an [intrinsic height](#).

If the two attributes are both zero, it indicates that the element is not intended for the user (e.g. it might be a part of a service to count page views).

The dimension attributes are not intended to be used to stretch the image.

User agent requirements: User agents are expected to use these attributes [as hints for the rendering](#).



[HTMLObjectElement/width](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLObjectElement/height](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

The *width* and *height* IDL attributes on the [iframe](#), [embed](#), [object](#), [source](#), and [video](#) elements must [reflect](#) the respective content attributes of the same name.

For [iframe](#), [embed](#) and [object](#) the IDL attributes are [DOMString](#); for [video](#) and [source](#) the IDL attributes are [unsigned long](#).

The corresponding IDL attributes for [img](#) and [input](#) elements are defined in those respective elements' sections, as they are slightly more specific to those elements' other behaviors.

4.9 Tabular data

4.9.1 The **table** element



[Element/table](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android Yes



[HTMLTableElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content](#).

[Palpable content.](#)

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected.

[Content model:](#)

In this order: optionally a [caption](#) element, followed by zero or more [colgroup](#) elements, followed optionally by a [thead](#) element, followed by either zero or more [tbody](#) elements or one or more [tr](#) elements, followed optionally by a [tfoot](#) element, optionally intermixed with one or more [script-supporting elements](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLTableElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute HTMLTableCaptionElement? caption;
  HTMLTableCaptionElement createCaption();
  [CEReactions] undefined deleteCaption();

  [CEReactions] attribute HTMLTableSectionElement? tHead;
  HTMLTableSectionElement createTHead();
  [CEReactions] undefined deleteTHead();

  [CEReactions] attribute HTMLTableSectionElement? tFoot;
  HTMLTableSectionElement createTFoot();
  [CEReactions] undefined deleteTFoot();

  [SameObject] readonly attribute HTMLCollection tBodies;
  HTMLTableSectionElement createTBody();

  [SameObject] readonly attribute HTMLCollection rows;
  HTMLTableRowElement insertRow(optional long index = -1);
  [CEReactions] undefined deleteRow(long index);

  // also has obsolete members
```

};

The [table](#) element [represents](#) data with more than one dimension, in the form of a [table](#).

The [table](#) element takes part in the [table model](#). Tables have rows, columns, and cells given by their descendants. The rows and columns form a grid; a table's cells must completely cover that grid without overlap.

Precise rules for determining whether this conformance requirement is met are described in the description of the [table model](#).

Authors are encouraged to provide information describing how to interpret complex tables. Guidance on how to [provide such information](#) is given below.

Tables must not be used as layout aids. Historically, some web authors have misused tables in HTML as a way to control their page layout. This usage is non-conforming, because tools attempting to extract tabular data from such documents would obtain very confusing results. In particular, users of accessibility tools like screen readers are likely to find it very difficult to navigate pages with tables used for layout.

There are a variety of alternatives to using HTML tables for layout, such as CSS grid layout, CSS flexible box layout ("flexbox"), CSS multi-column layout, CSS positioning, and the CSS table model. [\[CSS\]](#)

Tables can be complicated to understand and navigate. To help users with this, user agents should clearly delineate cells in a table from each other, unless the user agent has classified the table as a (non-conforming) layout table.

Authors and implementers are encouraged to consider using some of the [table design techniques](#) described below to make tables easier to navigate for users.

User agents, especially those that do table analysis on arbitrary content, are encouraged to find heuristics to determine which tables actually contain data and which are merely being used for layout. This specification does not define a precise heuristic, but the following are suggested as possible indicators:

Feature	Indication
The use of the role attribute with the value presentation	Probably a layout table
The use of the non-conforming border attribute with the non-conforming value 0	Probably a layout table
The use of the non-conforming cellspacing and cellpadding attributes with the value 0	Probably a layout table
The use of caption , thead , or th elements	Probably a non-layout table
The use of the headers and scope	Probably a non-layout table

Feature	Indication
attributes	
The use of the non-conforming border attribute with a value other than 0	Probably a non-layout table
Explicit visible borders set using CSS	Probably a non-layout table
The use of the summary attribute	Not a good indicator (both layout and non-layout tables have historically been given this attribute)

It is quite possible that the above suggestions are wrong. Implementers are urged to provide feedback elaborating on their experiences with trying to create a layout table detection heuristic.

If a [table](#) element has a (non-conforming) [summary](#) attribute, and the user agent has not classified the table as a layout table, the user agent may report the contents of that attribute to the user.

[table.caption \[= value \]](#)



[HTMLTableElement/caption](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns the table's [caption](#) element.

Can be set, to replace the [caption](#) element.

[caption = table.createCaption\(\)](#)



[HTMLTableElement/createCaption](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet1.0+ Opera Android12.1+

Ensures the table has a [caption](#) element, and returns it.

`table.deleteCaption()`

✓MDN

[HTMLTableElement/deleteCaption](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Ensures the table does not have a [caption](#) element.

`table.tHead [= value]`

✓MDN

[HTMLTableElement/tHead](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns the table's [thead](#) element.

Can be set, to replace the [thead](#) element. If the new value is not a [thead](#) element, throws a ["HierarchyRequestError"](#) [DOMException](#).

`thead = table.createTHead()`

✓MDN

[HTMLTableElement/createTHead](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Ensures the table has a [thead](#) element, and returns it.

`table.deleteTHead()`

✓MDN

[HTMLTableElement/deleteTHead](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Ensures the table does not have a [thead](#) element.

`table.tFoot [= value]`

✓MDN

[HTMLTableElement/tFoot](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Returns the table's [tfoot](#) element.

Can be set, to replace the [tfoot](#) element. If the new value is not a [tfoot](#) element, throws a ["HierarchyRequestError"](#) [DOMException](#).

`tfoot = table.createTFoot()`

✓MDN

[HTMLTableElement/createTFoot](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Ensures the table has a [tfoot](#) element, and returns it.

`table.deleteTFoot()`

✓MDN

[HTMLTableElement/deleteTFoot](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Ensures the table does not have a [tfoot](#) element.

`table.tBodies`

✓MDN

[HTMLTableElement/tBodies](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns an [HTMLCollection](#) of the [tbody](#) elements of the table.

`tbody = table.createTBody()`

✓MDN

[HTMLTableElement/createTBody](#)

Support in all current engines.

Firefox 25+ Safari 6+ Chrome 20+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 25+ Safari iOS 6+ Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 14+

Creates a [tbody](#) element, inserts it into the table, and returns it.

table.rows



[HTMLTableElement/rows](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns an [HTMLCollection](#) of the [tr](#) elements of the table.

tr = table.insertRow([index])



[HTMLTableElement/insertRow](#)

Support in all current engines.

Firefox 1+ Safari 4+ Chrome 1+

Opera 10+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

Creates a [tr](#) element, along with a [tbody](#) if required, inserts them into the table at the position given by the argument, and returns the [tr](#).

The position is relative to the rows in the table. The index `-1`, which is the default if the argument is omitted, is equivalent to inserting at the end of the table.

If the given position is less than `-1` or greater than the number of rows, throws an

["IndexSizeError" DOMException](#).

table.deleteRow(index)

✓MDN

[HTMLTableElement/deleteRow](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Removes the [tr](#) element with the given position in the table.

The position is relative to the rows in the table. The index -1 is equivalent to deleting the last row of the table.

If the given position is less than -1 or greater than the index of the last row, or if there are no rows, throws an ["IndexSizeError" DOMException](#).

In all of the following attribute and method definitions, when an element is to be *table-created*, that means to [create an element](#) given the [table](#) element's [node document](#), the given local name, and the [HTML namespace](#).

The *caption* IDL attribute must return, on getting, the first [caption](#) element child of the [table](#) element, if any, or null otherwise. On setting, the first [caption](#) element child of the [table](#) element, if any, must be removed, and the new value, if not null, must be inserted as the first node of the [table](#) element.

The *createCaption()* method must return the first [caption](#) element child of the [table](#) element, if any; otherwise a new [caption](#) element must be *table-created*, inserted as the first node of the [table](#) element, and then returned.

The *deleteCaption()* method must remove the first [caption](#) element child of the [table](#) element, if any.

The *tHead* IDL attribute must return, on getting, the first [thead](#) element child of the [table](#) element, if any, or null otherwise. On setting, if the new value is null or a [thead](#) element, the first [thead](#) element child of the [table](#) element, if any, must be removed, and the new value, if not null, must be inserted immediately before the first element in the [table](#) element that is neither a [caption](#) element nor a [colgroup](#) element, if any, or at the end of the table if there are no such elements. If the new value is neither null nor a [thead](#) element, then a ["HierarchyRequestError" DOMException](#) must be thrown instead.

The `createTHead()` method must return the first `thead` element child of the `table` element, if any; otherwise a new `thead` element must be table-created and inserted immediately before the first element in the `table` element that is neither a `caption` element nor a `colgroup` element, if any, or at the end of the table if there are no such elements, and then that new element must be returned.

The `deleteTHead()` method must remove the first `thead` element child of the `table` element, if any.

The `tFoot` IDL attribute must return, on getting, the first `tfoot` element child of the `table` element, if any, or null otherwise. On setting, if the new value is null or a `tfoot` element, the first `tfoot` element child of the `table` element, if any, must be removed, and the new value, if not null, must be inserted at the end of the table. If the new value is neither null nor a `tfoot` element, then a "[HierarchyRequestError](#)" `DOMException` must be thrown instead.

The `createTFoot()` method must return the first `tfoot` element child of the `table` element, if any; otherwise a new `tfoot` element must be table-created and inserted at the end of the table, and then that new element must be returned.

The `deleteTFoot()` method must remove the first `tfoot` element child of the `table` element, if any.

The `tBodies` attribute must return an [HTMLCollection](#) rooted at the `table` node, whose filter matches only `tbody` elements that are children of the `table` element.

The `createTBody()` method must table-create a new `tbody` element, insert it immediately after the last `tbody` element child in the `table` element, if any, or at the end of the `table` element if the `table` element has no `tbody` element children, and then must return the new `tbody` element.

The `rows` attribute must return an [HTMLCollection](#) rooted at the `table` node, whose filter matches only `tr` elements that are either children of the `table` element, or children of `thead`, `tbody`, or `tfoot` elements that are themselves children of the `table` element. The elements in the collection must be ordered such that those elements whose parent is a `thead` are included first, in [tree order](#), followed by those elements whose parent is either a `table` or `tbody` element, again in [tree order](#), followed finally by those elements whose parent is a `tfoot` element, still in [tree order](#).

The behavior of the `insertRow(index)` method depends on the state of the table. When it is called, the method must act as required by the first item in the following list of conditions that describes the state of the table and the `index` argument:

If `index` is less than `-1` or greater than the number of elements in `rows` collection:

The method must throw an "[IndexSizeError](#)" `DOMException`.

If the `rows` collection has zero elements in it, and the `table` has no `tbody` elements in it:

The method must `table-create` a `tbody` element, then `table-create` a `tr` element, then append the `tr` element to the `tbody` element, then append the `tbody` element to the `table` element, and finally return the `tr` element.

If the `rows` collection has zero elements in it:

The method must `table-create` a `tr` element, append it to the last `tbody` element in the table, and return the `tr` element.

If `index` is -1 or equal to the number of items in `rows` collection:

The method must `table-create` a `tr` element, and append it to the parent of the last `tr` element in the `rows` collection. Then, the newly created `tr` element must be returned.

Otherwise:

The method must `table-create` a `tr` element, insert it immediately before the `index`th `tr` element in the `rows` collection, in the same parent, and finally must return the newly created `tr` element.

When the `deleteRow(index)` method is called, the user agent must run the following steps:

1. If `index` is less than -1 or greater than or equal to the number of elements in the `rows` collection, then throw an `"IndexSizeError" DOMException`.
2. If `index` is -1 , then `remove` the last element in the `rows` collection from its parent, or do nothing if the `rows` collection is empty.
3. Otherwise, `remove` the `index`th element in the `rows` collection from its parent.

Here is an example of a table being used to mark up a Sudoku puzzle. Observe the lack of headers, which are not necessary in such a table.

```
<style>
  #sudoku { border-collapse: collapse; border: solid thick; }
  #sudoku colgroup, table#sudoku tbody { border: solid medium; }
  #sudoku td { border: solid thin; height: 1.4em; width: 1.4em; text-align: center; }
</style>
<h1>Today's Sudoku</h1>
<table id="sudoku">
  <colgroup><col><col><col>
  <colgroup><col><col><col>
  <colgroup><col><col><col>
  <tbody>
    <tr> <td> 1 <td> 2 <td> 3 <td> 4 <td> 5 <td> 6 <td> 7 <td> 8 <td> 9
    <tr> <td> 9 <td> 8 <td> 7 <td> 6 <td> 5 <td> 4 <td> 3 <td> 2 <td> 1
    <tr> <td> 5 <td> 4 <td> 3 <td> 2 <td> 1 <td> 6 <td> 7 <td> 8 <td> 9
  <tbody>
  <tr> <td> 6 <td> 7 <td> 8 <td> 9 <td> 1 <td> 2 <td> 3 <td> 4 <td> 5
```

```

<tr> <td>    <td>    <td>    <td>    <td>    <td>    <td>    <td>    <td>
<tr> <td> 5 <td>    <td>    <td> 9 <td>    <td> 7 <td>    <td>    <td> 1
<tbody>
<tr> <td> 6 <td>    <td>    <td> 5 <td>    <td>    <td>    <td> 2
<tr> <td>    <td>    <td>    <td> 7 <td>    <td>    <td>    <td>
<tr> <td> 9 <td>    <td> 8 <td>    <td> 2 <td>    <td>    <td> 5
</table>

```

4.9.1.1 Techniques for describing tables

For tables that consist of more than just a grid of cells with headers in the first row and headers in the first column, and for any table in general where the reader might have difficulty understanding the content, authors should include explanatory information introducing the table. This information is useful for all users, but is especially useful for users who cannot see the table, e.g. users of screen readers.

Such explanatory information should introduce the purpose of the table, outline its basic cell structure, highlight any trends or patterns, and generally teach the user how to use the table.

For instance, the following table:

Characteristics with positive and negative sides		
Negative	Characteristic	Positive
Sad	Mood	Happy
Failing	Grade	Passing

...might benefit from a description explaining the way the table is laid out, something like "Characteristics are given in the second column, with the negative side in the left column and the positive side in the right column".

There are a variety of ways to include this information, such as:

In prose, surrounding the table

```

<p>In the following table, characteristics are given in the second  

column, with the negative side in the left column and the positive  

side in the right column.</p>
<table>
  <caption>Characteristics with positive and negative sides</caption>
  <thead>
    <tr>
      <th id="n"> Negative
      <th> Characteristic
      <th> Positive
    </thead>
    <tbody>
      <tr>

```

```

<td headers="n r1"> Sad
<th id="r1"> Mood
<td> Happy
<tr>
  <td headers="n r2"> Failing
  <th id="r2"> Grade
  <td> Passing
</table>

```

In the table's [caption](#)

```

<table>
  <caption>
    <strong>Characteristics with positive and negative sides.</strong>
    <p>Characteristics are given in the second column, with the
      negative side in the left column and the positive side in the right
      column.</p>
  </caption>
  <thead>
    <tr>
      <th id="n"> Negative
      <th> Characteristic
      <th> Positive
    </thead>
    <tbody>
      <tr>
        <td headers="n r1"> Sad
        <th id="r1"> Mood
        <td> Happy
      <tr>
        <td headers="n r2"> Failing
        <th id="r2"> Grade
        <td> Passing
    </tbody>
</table>

```

In the table's [caption](#), in a [details](#) element

```

<table>
  <caption>
    <strong>Characteristics with positive and negative sides.</strong>
    <details>
      <summary>Help</summary>
      <p>Characteristics are given in the second column, with the
        negative side in the left column and the positive side in the right
        column.</p>
    </details>
  </caption>
  <thead>

```

```

<tr>
  <th id="n"> Negative
  <th> Characteristic
  <th> Positive
<tbody>
<tr>
  <td headers="n r1"> Sad
  <th id="r1"> Mood
  <td> Happy
<tr>
  <td headers="n r2"> Failing
  <th id="r2"> Grade
  <td> Passing
</table>

```

Next to the table, in the same [figure](#)

```

<figure>
  <figcaption>Characteristics with positive and negative sides</figcaption>
  <p>Characteristics are given in the second column, with the negative side in the left column and the positive side in the right column.</p>
  <table>
    <thead>
      <tr>
        <th id="n"> Negative
        <th> Characteristic
        <th> Positive
    <tbody>
      <tr>
        <td headers="n r1"> Sad
        <th id="r1"> Mood
        <td> Happy
      <tr>
        <td headers="n r2"> Failing
        <th id="r2"> Grade
        <td> Passing
    </table>
  </figure>

```

Next to the table, in a [figure](#)'s [figcaption](#)

```

<figure>
  <figcaption>
    <strong>Characteristics with positive and negative sides</strong>
    <p>Characteristics are given in the second column, with the negative side in the left column and the positive side in the right</p>
  </figcaption>

```

```

column.</p>
</figcaption>
<table>
  <thead>
    <tr>
      <th id="n"> Negative
      <th> Characteristic
      <th> Positive
  <tbody>
    <tr>
      <td headers="n r1"> Sad
      <th id="r1"> Mood
      <td> Happy
    <tr>
      <td headers="n r2"> Failing
      <th id="r2"> Grade
      <td> Passing
  </table>
</figure>

```

Authors may also use other techniques, or combinations of the above techniques, as appropriate.

The best option, of course, rather than writing a description explaining the way the table is laid out, is to adjust the table such that no explanation is needed.

In the case of the table used in the examples above, a simple rearrangement of the table so that the headers are on the top and left sides removes the need for an explanation as well as removing the need for the use of [headers](#) attributes:

```

<table>
  <caption>Characteristics with positive and negative sides</caption>
  <thead>
    <tr>
      <th> Characteristic
      <th> Negative
      <th> Positive
  <tbody>
    <tr>
      <th> Mood
      <td> Sad
      <td> Happy
    <tr>
      <th> Grade
      <td> Failing
      <td> Passing
  </table>

```

4.9.1.2 Techniques for table design

Good table design is key to making tables more readable and usable.

In visual media, providing column and row borders and alternating row backgrounds can be very effective to make complicated tables more readable.

For tables with large volumes of numeric content, using monospaced fonts can help users see patterns, especially in situations where a user agent does not render the borders.
(Unfortunately, for historical reasons, not rendering borders on tables is a common default.)

In speech media, table cells can be distinguished by reporting the corresponding headers before reading the cell's contents, and by allowing users to navigate the table in a grid fashion, rather than serializing the entire contents of the table in source order.

Authors are encouraged to use CSS to achieve these effects.

User agents are encouraged to render tables using these techniques whenever the page does not use CSS and the table is not classified as a layout table.

4.9.2 The ***caption*** element



[Element/caption](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLTableCaptionElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

Contexts in which this element can be used:

As the first element child of a [table](#) element.

Content model:

[Flow content](#), but with no descendant [table](#) elements.

Tag omission in text/html:

A [caption](#) element's [end tag](#) can be omitted if the [caption](#) element is not immediately followed by [ASCII whitespace](#) or a [comment](#).

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLTableCaptionElement : HTMLElement {
  HTMLConstructor constructor();
  // also has obsolete members
};
```

The [caption](#) element [represents](#) the title of the [table](#) that is its parent, if it has a parent and that is a [table](#) element.

The [caption](#) element takes part in the [table model](#).

When a [table](#) element is the only content in a [figure](#) element other than the [figcaption](#), the [caption](#) element should be omitted in favor of the [figcaption](#).

A caption can introduce context for a table, making it significantly easier to understand.

Consider, for instance, the following table:

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

In the abstract, this table is not clear. However, with a caption giving the table's number (for

[reference](#) in the main prose) and explaining its use, it makes more sense:

```
<caption>  
<p>Table 1.  
<p>This table shows the total score obtained from rolling two  
six-sided dice. The first row represents the value of the first die,  
the first column the value of the second die. The total is given in  
the cell that corresponds to the values of the two dice.  
</caption>
```

This provides the user with more context:

Table 1.

This table shows the total score obtained from rolling two six-sided dice. The first row represents the value of the first die, the first column the value of the second die. The total is given in the cell that corresponds to the values of the two dice.

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

4.9.3 The **colgroup** element



[Element/colgroup](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLTableColElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

None.

Contexts in which this element can be used:

As a child of a [table](#) element, after any [caption](#) elements and before any [thead](#), [tbody](#), [tfoot](#), and [tr](#) elements.

Content model:

If the [span](#) attribute is present: [Nothing](#).

If the [span](#) attribute is absent: Zero or more [col](#) and [template](#) elements.

Tag omission in text/html:

A [colgroup](#) element's [start tag](#) can be omitted if the first thing inside the [colgroup](#) element is a [col](#) element, and if the element is not immediately preceded by another [colgroup](#) element whose [end tag](#) has been omitted. (It can't be omitted if the element is empty.)

A [colgroup](#) element's [end tag](#) can be omitted if the [colgroup](#) element is not immediately followed by [ASCII whitespace](#) or a [comment](#).

Content attributes:

[Global attributes](#)

[span](#) — Number of columns spanned by the element

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLTableColElement : HTMLElement {
  [HTMLConstructor] constructor();
  [CEReactions] attribute unsigned long span;
  // also has obsolete members
};
```

The [colgroup](#) element [represents](#) a [group](#) of one or more [columns](#) in the [table](#) that is its

parent, if it has a parent and that is a [table](#) element.

If the [colgroup](#) element contains no [col](#) elements, then the element may have a *span* content attribute specified, whose value must be a [valid non-negative integer](#) greater than zero and less than or equal to 1000.

The [colgroup](#) element and its [span](#) attribute take part in the [table model](#).

The *span* IDL attribute must [reflect](#) the content attribute of the same name. It is [clamped to the range](#) [1, 1000], and its default value is 1.

4.9.4 The **col** element



[Element/col](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As a child of a [colgroup](#) element that doesn't have a [span](#) attribute.

[Content model:](#)

[Nothing](#).

[Tag omission in text/html:](#)

No [end tag](#).

[Content attributes:](#)

[Global attributes](#)

[span](#) — Number of columns spanned by the element

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

DOM interface:

Uses [HTMLTableColElement](#), as defined for [colgroup](#) elements.

If a [col](#) element has a parent and that is a [colgroup](#) element that itself has a parent that is a [table](#) element, then the [col](#) element [represents](#) one or more [columns](#) in the [column group](#) represented by that [colgroup](#).

The element may have a [*span*](#) content attribute specified, whose value must be a [valid non-negative integer](#) greater than zero and less than or equal to 1000.

The [col](#) element and its [*span*](#) attribute take part in the [table model](#).

The [*span*](#) IDL attribute must [reflect](#) the content attribute of the same name. It is [clamped to the range](#) [1, 1000], and its default value is 1.

4.9.5 The ***tbody*** element



Element/tbody

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



HTMLTableSectionElement

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

None.

Contexts in which this element can be used:

As a child of a [table](#) element, after any [caption](#), [colgroup](#), and [thead](#) elements, but only if there are no [tr](#) elements that are children of the [table](#) element.

Content model:

Zero or more [tr](#) and [script-supporting](#) elements.

Tag omission in text/html:

A [tbody](#) element's [start tag](#) can be omitted if the first thing inside the [tbody](#) element is a [tr](#) element, and if the element is not immediately preceded by a [tbody](#), [thead](#), or [tfoot](#) element whose [end tag](#) has been omitted. (It can't be omitted if the element is empty.)

A [tbody](#) element's [end tag](#) can be omitted if the [tbody](#) element is immediately followed by a [tbody](#) or [tfoot](#) element, or if there is no more content in the parent element.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLTableSectionElement : HTMLElement {
  [HTMLConstructor] constructor();

  [SameObject] readonly attribute HTMLCollection rows;
  HTMLTableRowElement insertRow(optional long index = -1);
  [CEReactions] undefined deleteRow(long index);

  // also has obsolete members
};
```

The [HTMLTableSectionElement](#) interface is also used for [thead](#) and [tfoot](#) elements.

The [tbody](#) element [represents](#) a [block](#) of [rows](#) that consist of a body of data for the parent [table](#) element, if the [tbody](#) element has a parent and it is a [table](#).

The [tbody](#) element takes part in the [table model](#).

[tbody.rows](#)

Returns an [HTMLCollection](#) of the [tr](#) elements of the table section.

[tr = tbody.insertRow\(\[index \]\)](#)

Creates a [tr](#) element, inserts it into the table section at the position given by the argument, and returns the [tr](#).

The position is relative to the rows in the table section. The index -1 , which is the default if the argument is omitted, is equivalent to inserting at the end of the table section.

If the given position is less than -1 or greater than the number of rows, throws an ["IndexSizeError" DOMException](#).

`tbody.deleteRow(index)`

Removes the `tr` element with the given position in the table section.

The position is relative to the rows in the table section. The index -1 is equivalent to deleting the last row of the table section.

If the given position is less than -1 or greater than the index of the last row, or if there are no rows, throws an ["IndexSizeError" DOMException](#).

The `rows` attribute must return an [HTMLCollection](#) rooted at this element, whose filter matches only `tr` elements that are children of this element.

The `insertRow(index)` method must act as follows:

1. If `index` is less than -1 or greater than the number of elements in the `rows` collection, throw an ["IndexSizeError" DOMException](#).
2. Let `table row` be the result of [creating an element](#) given this element's [node document](#), `tr`, and the [HTML namespace](#).
3. If `index` is -1 or equal to the number of items in the `rows` collection, then [append](#) `table row` to this element.
4. Otherwise, [insert](#) `table row` as a child of this element, immediately before the `indexth tr` element in the `rows` collection.
5. Return `table row`.

The `deleteRow(index)` method must, when invoked, act as follows:

1. If `index` is less than -1 or greater than or equal to the number of elements in the `rows` collection, then throw an ["IndexSizeError" DOMException](#).
2. If `index` is -1 , then [remove](#) the last element in the `rows` collection from this element, or do nothing if the `rows` collection is empty.
3. Otherwise, [remove](#) the `indexth` element in the `rows` collection from this element.

4.9.6 The **`thead`** element

✓MDN

Element/`thead`

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

None.

Contexts in which this element can be used:

As a child of a `table` element, after any `caption`, and `colgroup` elements and before any `tbody`, `tfoot`, and `tr` elements, but only if there are no other `thead` elements that are children of the `table` element.

Content model:

Zero or more `tr` and `script-supporting` elements.

Tag omission in text/html:

A `thead` element's end tag can be omitted if the `thead` element is immediately followed by a `tbody` or `tfoot` element.

Content attributes:

Global attributes

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses `HTMLTableSectionElement`, as defined for `tbody` elements.

The `thead` element represents the block of rows that consist of the column labels (headers) for the parent `table` element, if the `thead` element has a parent and it is a `table`.

The `thead` element takes part in the table model.

This example shows a `thead` element being used. Notice the use of both `th` and `td` elements in the `thead` element: the first row is the headers, and the second row is an explanation of how to fill in the table.

```

<table>
  <caption> School auction sign-up sheet </caption>
  <thead>
    <tr>
      <th><label for=e1>Name</label>
      <th><label for=e2>Product</label>
      <th><label for=e3>Picture</label>
      <th><label for=e4>Price</label>
    <tr>
      <td>Your name here
      <td>What are you selling?
      <td>Link to a picture
      <td>Your reserve price
  <tbody>
    <tr>
      <td>Ms Danus
      <td>Doughnuts
      <td>
      <td>$45
    <tr>
      <td><input id=e1 type=text name=who required form=f>
      <td><input id=e2 type=text name=what required form=f>
      <td><input id=e3 type=url name=pic form=f>
      <td><input id=e4 type=number step=0.01 min=0 value=0 required form=f>
</table>
<form id=f action="/auction.cgi">
  <input type=button name=add value="Submit">
</form>

```

4.9.7 The ***tfoot*** element



Element/tfoot

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Categories:

None.

Contexts in which this element can be used:

As a child of a [table](#) element, after any [caption](#), [colgroup](#), [thead](#), [tbody](#), and [tr](#) elements, but only if there are no other [tfoot](#) elements that are children of the [table](#) element.

Content model:

Zero or more [tr](#) and [script-supporting](#) elements.

Tag omission in text/html:

A [tfoot](#) element's [end tag](#) can be omitted if there is no more content in the parent element.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

Uses [HTMLTableSectionElement](#), as defined for [tbody](#) elements.

The [tfoot](#) element [represents](#) the [block](#) of [rows](#) that consist of the column summaries (footers) for the parent [table](#) element, if the [tfoot](#) element has a parent and it is a [table](#).

The [tfoot](#) element takes part in the [table model](#).

4.9.8 The **tr** element

✓MDN

Element/tr

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

HTMLTableRowElement

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As a child of a [thead](#) element.

As a child of a [tbody](#) element.

As a child of a [tfoot](#) element.

As a child of a [table](#) element, after any [caption](#), [colgroup](#), and [thead](#) elements, but only if there are no [tbody](#) elements that are children of the [table](#) element.

[Content model:](#)

Zero or more [td](#), [th](#), and [script-supporting](#) elements.

[Tag omission in text/html:](#)

A [tr](#) element's [end tag](#) can be omitted if the [tr](#) element is immediately followed by another [tr](#) element, or if there is no more content in the parent element.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLTableRowElement : HTMLElement {
  [HTMLConstructor] constructor();

  readonly attribute long rowIndex;
  readonly attribute long sectionRowIndex;
  [SameObject] readonly attribute HTMLCollection cells;
  HTMLTableCellElement insertCell(optional long index = -1);
  [CEReactions] undefined deleteCell(long index);

  // also has obsolete members
};
```

The [tr](#) element represents a row of cells in a table.

The [tr](#) element takes part in the [table model](#).

tr.rowIndex

✓MDN

[HTMLTableRowElement\(rowIndex\)](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the position of the row in the table's [rows](#) list.

Returns -1 if the element isn't in a table.

tr.sectionRowIndex

Returns the position of the row in the table section's [rows](#) list.

Returns -1 if the element isn't in a table section.

tr.cells

Returns an [HTMLCollection](#) of the [td](#) and [th](#) elements of the row.

cell = tr.insertCell([index])

✓MDN

[HTMLTableRowElement/insertCell](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Creates a [td](#) element, inserts it into the table row at the position given by the argument, and returns the [td](#).

The position is relative to the cells in the row. The index -1 , which is the default if the argument is omitted, is equivalent to inserting at the end of the row.

If the given position is less than -1 or greater than the number of cells, throws an ["IndexSizeError" DOMException](#).

`tr.deleteCell(index)`

Removes the `td` or `th` element with the given position in the row.

The position is relative to the cells in the row. The index -1 is equivalent to deleting the last cell of the row.

If the given position is less than -1 or greater than the index of the last cell, or if there are no cells, throws an ["IndexSizeError" DOMException](#).

The `rowIndex` attribute must, if this element has a parent `table` element, or a parent `tbody`, `thead`, or `tfoot` element and a *grandparent* `table` element, return the index of this `tr` element in that `table` element's `rows` collection. If there is no such `table` element, then the attribute must return -1 .

The `sectionRowIndex` attribute must, if this element has a parent `table`, `tbody`, `thead`, or `tfoot` element, return the index of the `tr` element in the parent element's `rows` collection (for tables, that's `HTMLTableElement`'s `rows` collection; for table sections, that's `HTMLTableSectionElement`'s `rows` collection). If there is no such parent element, then the attribute must return -1 .

The `cells` attribute must return an `HTMLCollection` rooted at this `tr` element, whose filter matches only `td` and `th` elements that are children of the `tr` element.

The `insertCell(index)` method must act as follows:

1. If `index` is less than -1 or greater than the number of elements in the `cells` collection, then throw an ["IndexSizeError" DOMException](#).
2. Let *table cell* be the result of [creating an element](#) given this `tr` element's [node document](#), `td`, and the [HTML namespace](#).
3. If `index` is equal to -1 or equal to the number of items in `cells` collection, then [append table cell](#) to this `tr` element.
4. Otherwise, [insert table cell](#) as a child of this `tr` element, immediately before the `index`th `td` or `th` element in the `cells` collection.
5. Return *table cell*.

The `deleteCell(index)` method must act as follows:

1. If *index* is less than -1 or greater than or equal to the number of elements in the [cells](#) collection, then throw an ["IndexSizeError" DOMException](#).
2. If *index* is -1 , then [remove](#) the last element in the [cells](#) collection from its parent, or do nothing if the [cells](#) collection is empty.
3. Otherwise, [remove](#) the *index*th element in the [cells](#) collection from its parent.

4.9.9 The **td** element

✓MDN

[Element/td](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

✓MDN

[HTMLTableCellElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

[Sectioning root](#).

Contexts in which this element can be used:

As a child of a [tr](#) element.

Content model:

[Flow content](#).

Tag omission in text/html:

A [td](#) element's [end tag](#) can be omitted if the [td](#) element is immediately followed by a [td](#) or [th](#) element, or if there is no more content in the parent element.

Content attributes:

[Global attributes](#)

[colspan](#) — Number of columns that the cell is to span

[rowspan](#) — Number of rows that the cell is to span

[headers](#) — The header cells for this cell

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLTableCellElement : HTMLElement {
    [HTMLConstructor] constructor();

    [CEReactions] attribute unsigned long colSpan;
    [CEReactions] attribute unsigned long rowSpan;
    [CEReactions] attribute DOMString headers;
    readonly attribute long cellIndex;

    [CEReactions] attribute DOMString scope; // only conforming for th elements
    [CEReactions] attribute DOMString abbr; // only conforming for th elements

    // also has obsolete members
};
```

The [HTMLTableCellElement](#) interface is also used for [th](#) elements.

The [td](#) element [represents](#) a data [cell](#) in a table.

The [td](#) element and its [colspan](#), [rowspan](#), and [headers](#) attributes take part in the [table model](#).

User agents, especially in non-visual environments or where displaying the table as a 2D grid is impractical, may give the user context for the cell when rendering the contents of a cell; for instance, giving its position in the [table model](#), or listing the cell's header cells (as determined by the [algorithm for assigning header cells](#)). When a cell's header cells are being listed, user agents may use the value of [abbr](#) attributes on those header cells, if any, instead of the contents of the header cells themselves.

In this example, we see a snippet of a web application consisting of a grid of editable cells (essentially a simple spreadsheet). One of the cells has been configured to show the sum of the cells above it. Three have been marked as headings, which use [th](#) elements instead of [td](#)

elements. A script would attach event handlers to these elements to maintain the total.

```
<table>
  <tr>
    <th><input value="Name">
    <th><input value="Paid ($)">
  <tr>
    <td><input value="Jeff">
    <td><input value="14">
  <tr>
    <td><input value="Britta">
    <td><input value="9">
  <tr>
    <td><input value="Abed">
    <td><input value="25">
  <tr>
    <td><input value="Shirley">
    <td><input value="2">
  <tr>
    <td><input value="Annie">
    <td><input value="5">
  <tr>
    <td><input value="Troy">
    <td><input value="5">
  <tr>
    <td><input value="Pierce">
    <td><input value="1000">
  <tr>
    <th><input value="Total">
    <td><output value="1060">
</table>
```

4.9.10 The **th** element

✓MDN

[Element/th](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

Categories:

None.

Contexts in which this element can be used:

As a child of a [tr](#) element.

Content model:

Flow content, but with no [header](#), [footer](#), [sectioning content](#), or [heading content](#) descendants.

Tag omission in text/html:

A [th](#) element's [end tag](#) can be omitted if the [th](#) element is immediately followed by a [td](#) or [th](#) element, or if there is no more content in the parent element.

Content attributes:

Global attributes

[colspan](#) — Number of columns that the cell is to span

[rowspan](#) — Number of rows that the cell is to span

[headers](#) — The header cells for this cell

[scope](#) — Specifies which cells the header cell applies to

[abbr](#) — Alternative label to use for the header cell when referencing the cell in other contexts

Accessibility considerations:

For authors.

For implementers.

DOM interface:

Uses [HTMLTableCellElement](#), as defined for [td](#) elements.

The [th](#) element [represents](#) a header [cell](#) in a table.

The [th](#) element may have a [scope](#) content attribute specified. The [scope](#) attribute is an [enumerated attribute](#) with five states, four of which have explicit keywords:

The **row** keyword, which maps to the *row* state

The *row* state means the header cell applies to some of the subsequent cells in the same row(s).

The **col** keyword, which maps to the *column* state

The *column* state means the header cell applies to some of the subsequent cells in the same column(s).

The **`rowgroup`** keyword, which maps to the *row group* state

The *row group* state means the header cell applies to all the remaining cells in the row group. A `th` element's `scope` attribute must not be in the *row group* state if the element is not anchored in a *row group*.

The **`colgroup`** keyword, which maps to the *column group* state

The *column group* state means the header cell applies to all the remaining cells in the column group. A `th` element's `scope` attribute must not be in the *column group* state if the element is not anchored in a *column group*.

The **`auto`** state

The `auto` state makes the header cell apply to a set of cells selected based on context.

The `scope` attribute's *missing value default* and *invalid value default* are the `auto` state.

The `th` element may have an `abbr` content attribute specified. Its value must be an alternative label for the header cell, to be used when referencing the cell in other contexts (e.g. when describing the header cells that apply to a data cell). It is typically an abbreviated form of the full header cell, but can also be an expansion, or merely a different phrasing.

The `th` element and its `colspan`, `rowspan`, `headers`, and `scope` attributes take part in the [table model](#).

The following example shows how the `scope` attribute's `rowgroup` value affects which data cells a header cell applies to.

Here is a markup fragment showing a table:

```
<table>
  <thead>
    <tr> <th> ID <th> Measurement <th> Average <th> Maximum
  <tbody>
    <tr> <td> <th scope=rowgroup> Cats <td> <td>
    <tr> <td> 93 <th scope=row> Legs <td> 3.5 <td> 4
    <tr> <td> 10 <th scope=row> Tails <td> 1 <td> 1
  <tbody>
    <tr> <td> <th scope=rowgroup> English speakers <td> <td>
    <tr> <td> 32 <th scope=row> Legs <td> 2.67 <td> 4
    <tr> <td> 35 <th scope=row> Tails <td> 0.33 <td> 1
</table>
```

This would result in the following table:

ID	Measurement	Average	Maximum
Cats			
93	Legs	3.5	4
10	Tails	1	1

ID	Measurement	Average	Maximum
English speakers			
32	Legs	2.67	4
35	Tails	0.33	1

The headers in the first row all apply directly down to the rows in their column.

The headers with the explicit [scope](#) attributes apply to all the cells in their row group other than the cells in the first column.

The remaining headers apply just to the cells to the right of them.

ID	Measurement	Average	Maximum
	Cats		
93	Legs	3.5	4
10	Tails	1	1
English speakers			
32	Legs	2.67	4
35	Tails	0.33	1

4.9.11 Attributes common to [td](#) and [th](#) elements

The [td](#) and [th](#) elements may have a *colspan* content attribute specified, whose value must be a [valid non-negative integer](#) greater than zero and less than or equal to 1000.

The [td](#) and [th](#) elements may also have a *rowspan* content attribute specified, whose value must be a [valid non-negative integer](#) less than or equal to 65534. For this attribute, the value zero means that the cell is to span all the remaining rows in the row group.

These attributes give the number of columns and rows respectively that the cell is to span. These attributes must not be used to overlap cells, as described in the description of the [table model](#).

The [td](#) and [th](#) element may have a *headers* content attribute specified. The [headers](#) attribute, if specified, must contain a string consisting of an [unordered set of unique space-separated tokens](#), none of which are [identical to](#) another token and each of which must have the value of an [ID](#) of a [th](#) element taking part in the same [table](#) as the [td](#) or [th](#) element (as defined by the [table model](#)).

A [th](#) element with ID *id* is said to be *directly targeted* by all [td](#) and [th](#) elements in the same [table](#) that have [headers](#) attributes whose values include as one of their tokens the ID *id*. A [th](#) element *A* is said to be *targeted* by a [th](#) or [td](#) element *B* if either *A* is *directly targeted* by *B* or if there exists an element *C* that is itself *targeted* by the element *B* and *A* is *directly targeted* by *C*.

A [th](#) element must not be *targeted* by itself.

The [colspan](#), [rowspan](#), and [headers](#) attributes take part in the [table model](#).

cell.cellIndex

Returns the position of the cell in the row's [cells](#) list. This does not necessarily correspond to the x-position of the cell in the table, since earlier cells might cover multiple rows or columns.

Returns -1 if the element isn't in a row.

The [colSpan](#) IDL attribute must [reflect](#) the [colspan](#) content attribute. It is [clamped to the range](#) $[1, 1000]$, and its default value is 1 .

The [rowSpan](#) IDL attribute must [reflect](#) the [rowspan](#) content attribute. It is [clamped to the range](#) $[0, 65534]$, and its default value is 1 .

The [headers](#) IDL attribute must [reflect](#) the content attribute of the same name.

The [cellIndex](#) IDL attribute must, if the element has a parent [tr](#) element, return the index of the cell's element in the parent element's [cells](#) collection. If there is no such parent element, then the attribute must return -1 .

The [scope](#) IDL attribute must [reflect](#) the content attribute of the same name, [limited to only known values](#).

The [abbr](#) IDL attribute must [reflect](#) the content attribute of the same name.

4.9.12 Processing model

The various table elements and their content attributes together define the *table model*.

A *table* consists of cells aligned on a two-dimensional grid of *slots* with coordinates (x, y) . The grid is finite, and is either empty or has one or more slots. If the grid has one or more slots, then the *x* coordinates are always in the range $0 \leq x < x_{width}$, and the *y* coordinates are always in the range $0 \leq y < y_{height}$. If one or both of x_{width} and y_{height} are zero, then the table is empty (has no slots). Tables correspond to [table](#) elements.

A *cell* is a set of slots anchored at a slot ($cell_x, cell_y$), and with a particular *width* and *height*

such that the cell covers all the slots with coordinates (x, y) where $cell_x \leq x < cell_x + width$ and $cell_y \leq y < cell_y + height$. Cells can either be *data cells* or *header cells*. Data cells correspond to [td](#) elements, and header cells correspond to [th](#) elements. Cells of both types can have zero or more associated header cells.

It is possible, in certain error cases, for two cells to occupy the same slot.

A *row* is a complete set of slots from $x=0$ to $x=x_{width}-1$, for a particular value of y . Rows usually correspond to [tr](#) elements, though a [row group](#) can have some implied [rows](#) at the end in some cases involving [cells](#) spanning multiple rows.

A *column* is a complete set of slots from $y=0$ to $y=y_{height}-1$, for a particular value of x . Columns can correspond to [col](#) elements. In the absence of [col](#) elements, columns are implied.

A *row group* is a set of [rows](#) anchored at a slot $(0, group_y)$ with a particular *height* such that the row group covers all the slots with coordinates (x, y) where $0 \leq x < x_{width}$ and $group_y \leq y < group_y + height$. Row groups correspond to [tbody](#), [thead](#), and [tfoot](#) elements. Not every row is necessarily in a row group.

A *column group* is a set of [columns](#) anchored at a slot $(group_x, 0)$ with a particular *width* such that the column group covers all the slots with coordinates (x, y) where $group_x \leq x < group_x + width$ and $0 \leq y < y_{height}$. Column groups correspond to [colgroup](#) elements. Not every column is necessarily in a column group.

[Row groups](#) cannot overlap each other. Similarly, [column groups](#) cannot overlap each other.

A [cell](#) cannot cover slots that are from two or more [row groups](#). It is, however, possible for a cell to be in multiple [column groups](#). All the slots that form part of one cell are part of zero or one [row groups](#) and zero or more [column groups](#).

In addition to [cells](#), [columns](#), [rows](#), [row groups](#), and [column groups](#), [tables](#) can have a [caption](#) element associated with them. This gives the table a heading, or legend.

A *table model error* is an error with the data represented by [table](#) elements and their descendants. Documents must not have table model errors.

4.9.12.1 Forming a table

To determine which elements correspond to which slots in a [table](#) associated with a [table](#) element, to determine the dimensions of the table (x_{width} and y_{height}), and to determine if there are any [table model errors](#), user agents must use the following algorithm:

1. Let x_{width} be zero.
2. Let y_{height} be zero.

3. Let *pending tfoot* elements be a list of [tfoot](#) elements, initially empty.
4. Let *the table* be the [table](#) represented by the [table](#) element. The *xwidth* and *yheight* variables give *the table*'s dimensions. *The table* is initially empty.
5. If the [table](#) element has no children elements, then return *the table* (which will be empty).
6. Associate the first [caption](#) element child of the [table](#) element with *the table*. If there are no such children, then it has no associated [caption](#) element.
7. Let the *current element* be the first element child of the [table](#) element.

If a step in this algorithm ever requires the *current element* to be *advanced to the next child of the table* when there is no such next child, then the user agent must jump to the step labeled *end*, near the end of this algorithm.

8. While the *current element* is not one of the following elements, [advance](#) the *current element* to the next child of the [table](#):
 - [colgroup](#)
 - [thead](#)
 - [tbody](#)
 - [tfoot](#)
 - [tr](#)
9. If the *current element* is a [colgroup](#), follow these substeps:

1. *Column groups*: Process the *current element* according to the appropriate case below:

If the *current element* has any [col](#) element children

Follow these steps:

1. Let *xstart* have the value of *xwidth*.
2. Let the *current column* be the first [col](#) element child of the [colgroup](#) element.
3. *Columns*: If the *current column* [col](#) element has a *span* attribute, then parse its value using the [rules for parsing non-negative integers](#).

If the result of parsing the value is not an error or zero, then let *span* be that value.

Otherwise, if the `col` element has no `span` attribute, or if trying to parse the attribute's value resulted in an error or zero, then let `span` be 1.

If `span` is greater than 1000, let it be 1000 instead.

4. Increase x_{width} by `span`.
5. Let the last `span` `columns` in *the table* correspond to the *current column* `col` element.
6. If *current column* is not the last `col` element child of the `colgroup` element, then let the *current column* be the next `col` element child of the `colgroup` element, and return to the step labeled `columns`.
7. Let all the last `columns` in *the table* from $x=x_{start}$ to $x=x_{width}-1$ form a new `column group`, anchored at the slot $(x_{start}, 0)$, with width $x_{width}-x_{start}$, corresponding to the `colgroup` element.

If the *current element* has no `col` element children

1. If the `colgroup` element has a `span` attribute, then parse its value using the [rules for parsing non-negative integers](#).

If the result of parsing the value is not an error or zero, then let `span` be that value.

Otherwise, if the `colgroup` element has no `span` attribute, or if trying to parse the attribute's value resulted in an error or zero, then let `span` be 1.

If `span` is greater than 1000, let it be 1000 instead.

2. Increase x_{width} by `span`.
 3. Let the last `span` `columns` in *the table* form a new `column group`, anchored at the slot $(x_{width}-span, 0)$, with width `span`, corresponding to the `colgroup` element.
2. [Advance](#) the *current element* to the next child of the `table`.
 3. While the *current element* is not one of the following elements, [advance](#) the *current element* to the next child of the `table`:
 - `colgroup`
 - `thead`
 - `tbody`

- [tfoot](#)
 - [tr](#)
4. If the *current element* is a [colgroup](#) element, jump to the step labeled *column groups* above.
 10. Let $y_{current}$ be zero.
 11. Let the *list of downward-growing cells* be an empty list.
 12. *Rows*: While the *current element* is not one of the following elements, [advance](#) the *current element* to the next child of the [table](#):
 - [thead](#)
 - [tbody](#)
 - [tfoot](#)
 - [tr](#)
 13. If the *current element* is a [tr](#), then run the [algorithm for processing rows](#), [advance](#) the *current element* to the next child of the [table](#), and return to the step labeled *rows*.
 14. Run the [algorithm for ending a row group](#).
 15. If the *current element* is a [tfoot](#), then add that element to the list of *pending tfoot elements*, [advance](#) the *current element* to the next child of the [table](#), and return to the step labeled *rows*.
 16. The *current element* is either a [thead](#) or a [tbody](#).
Run the [algorithm for processing row groups](#).
 17. [Advance](#) the *current element* to the next child of the [table](#).
 18. Return to the step labeled *rows*.
 19. *End*: For each [tfoot](#) element in the list of *pending tfoot elements*, in [tree order](#), run the [algorithm for processing row groups](#).
 20. If there exists a [row](#) or [column](#) in *the table* containing only [slots](#) that do not have a [cell](#) anchored to them, then this is a [table model error](#).
 21. Return *the table*.

The *algorithm for processing row groups*, which is invoked by the set of steps above for processing [thead](#), [tbody](#), and [tfoot](#) elements, is:

1. Let y_{start} have the value of y_{height} .

2. For each **tr** element that is a child of the element being processed, in tree order, run the [algorithm for processing rows](#).
3. If $y_{height} > y_{start}$, then let all the last **rows** in *the table* from $y=y_{start}$ to $y=y_{height}-1$ form a new [row group](#), anchored at the slot with coordinate $(0, y_{start})$, with height $y_{height}-y_{start}$, corresponding to the element being processed.
4. Run the [algorithm for ending a row group](#).

The *algorithm for ending a row group*, which is invoked by the set of steps above when starting and ending a block of rows, is:

1. While $y_{current}$ is less than y_{height} , follow these steps:
 1. Run the [algorithm for growing downward-growing cells](#).
 2. Increase $y_{current}$ by 1.
2. Empty the *list of downward-growing cells*.

The *algorithm for processing rows*, which is invoked by the set of steps above for processing **tr** elements, is:

1. If y_{height} is equal to $y_{current}$, then increase y_{height} by 1. ($y_{current}$ is never greater than y_{height} .)
2. Let $x_{current}$ be 0.
3. Run the [algorithm for growing downward-growing cells](#).
4. If the **tr** element being processed has no **td** or **th** element children, then increase $y_{current}$ by 1, abort this set of steps, and return to the algorithm above.
5. Let *current cell* be the first **td** or **th** element child in the **tr** element being processed.
6. *Cells*: While $x_{current}$ is less than x_{width} and the slot with coordinate $(x_{current}, y_{current})$ already has a cell assigned to it, increase $x_{current}$ by 1.
7. If $x_{current}$ is equal to x_{width} , increase x_{width} by 1. ($x_{current}$ is never greater than x_{width} .)
8. If the *current cell* has a **colspan** attribute, then [parse that attribute's value](#), and let *colspan* be the result.

If parsing that value failed, or returned zero, or if the attribute is absent, then let *colspan* be 1, instead.

If *colspan* is greater than 1000, let it be 1000 instead.

- If the *current cell* has a [rowspan](#) attribute, then [parse that attribute's value](#), and let *rowspan* be the result.

If parsing that value failed or if the attribute is absent, then let *rowspan* be 1, instead.

If *rowspan* is greater than 65534, let it be 65534 instead.

- If *rowspan* is zero and the [table](#) element's [node document](#) is not set to [quirks mode](#), then let *cell grows downward* be true, and set *rowspan* to 1. Otherwise, let *cell grows downward* be false.
- If $x_{width} < x_{current} + colspan$, then let x_{width} be $x_{current} + colspan$.
- If $y_{height} < y_{current} + rowspan$, then let y_{height} be $y_{current} + rowspan$.
- Let the slots with coordinates (x, y) such that $x_{current} \leq x < x_{current} + colspan$ and $y_{current} \leq y < y_{current} + rowspan$ be covered by a new [cell](#) *c*, anchored at $(x_{current}, y_{current})$, which has width *colspan* and height *rowspan*, corresponding to the *current cell* element.

If the *current cell* element is a [th](#) element, let this new cell *c* be a header cell; otherwise, let it be a data cell.

To establish which header cells apply to the *current cell* element, use the [algorithm for assigning header cells](#) described in the next section.

If any of the slots involved already had a [cell](#) covering them, then this is a [table model error](#). Those slots now have two cells overlapping.

- If *cell grows downward* is true, then add the tuple $\{c, x_{current}, colspan\}$ to the *list of downward-growing cells*.
- Increase $x_{current}$ by *colspan*.
- If *current cell* is the last [td](#) or [th](#) element child in the [tr](#) element being processed, then increase $y_{current}$ by 1, abort this set of steps, and return to the algorithm above.
- Let *current cell* be the next [td](#) or [th](#) element child in the [tr](#) element being processed.
- Return to the step labeled *cells*.

When the algorithms above require the user agent to run the *algorithm for growing downward-growing cells*, the user agent must, for each $\{cell, cell_x, width\}$ tuple in the *list of downward-growing cells*, if any, extend the [cell](#) *cell* so that it also covers the slots with coordinates $(x, y_{current})$, where $cell_x \leq x < cell_x + width$.

4.9.12.2 Forming relationships between data cells and header cells

Each cell can be assigned zero or more header cells. The *algorithm for assigning header cells to a cell principal cell* is as follows.

1. Let *header list* be an empty list of cells.
2. Let $(principal_x, principal_y)$ be the coordinate of the slot to which the *principal cell* is anchored.
3. If the *principal cell* has a **headers** attribute specified
 1. Take the value of the *principal cell's headers* attribute and [split it on ASCII whitespace](#), letting *id list* be the list of tokens obtained.
 2. For each token in the *id list*, if the first element in the [Document](#) with an [ID](#) equal to the token is a cell in the same [table](#), and that cell is not the *principal cell*, then add that cell to *header list*.

If *principal cell* does not have a **headers** attribute specified

1. Let $principal_{width}$ be the width of the *principal cell*.
 2. Let $principal_{height}$ be the height of the *principal cell*.
 3. For each value of y from $principal_y$ to $principal_y + principal_{height} - 1$, run the [internal algorithm for scanning and assigning header cells](#), with the *principal cell*, the *header list*, the initial coordinate $(principal_x, y)$, and the increments $\Delta x = -1$ and $\Delta y = 0$.
 4. For each value of x from $principal_x$ to $principal_x + principal_{width} - 1$, run the [internal algorithm for scanning and assigning header cells](#), with the *principal cell*, the *header list*, the initial coordinate $(x, principal_y)$, and the increments $\Delta x = 0$ and $\Delta y = -1$.
 5. If the *principal cell* is anchored in a [row group](#), then add all header cells that are [row group headers](#) and are anchored in the same row group with an x -coordinate less than or equal to $principal_x + principal_{width} - 1$ and a y -coordinate less than or equal to $principal_y + principal_{height} - 1$ to *header list*.
 6. If the *principal cell* is anchored in a [column group](#), then add all header cells that are [column group headers](#) and are anchored in the same column group with an x -coordinate less than or equal to $principal_x + principal_{width} - 1$ and a y -coordinate less than or equal to $principal_y + principal_{height} - 1$ to *header list*.
4. Remove all the [empty cells](#) from the *header list*.

5. Remove any duplicates from the *header list*.
6. Remove *principal cell* from the *header list* if it is there.
7. Assign the headers in the *header list* to the *principal cell*.

The *internal algorithm for scanning and assigning header cells*, given a *principal cell*, a *header list*, an initial coordinate ($initial_x$, $initial_y$), and Δx and Δy increments, is as follows:

1. Let x equal $initial_x$.
2. Let y equal $initial_y$.
3. Let *opaque headers* be an empty list of cells.
4. If *principal cell* is a header cell

Let *in header block* be true, and let *headers from current header block* be a list of cells containing just the *principal cell*.

Otherwise

Let *in header block* be false and let *headers from current header block* be an empty list of cells.

5. *Loop*: Increment x by Δx ; increment y by Δy .

For each invocation of this algorithm, one of Δx and Δy will be -1 , and the other will be 0 .

6. If either x or y are less than 0, then abort this internal algorithm.
7. If there is no cell covering slot (x, y) , or if there is more than one cell covering slot (x, y) , return to the substep labeled *loop*.
8. Let *current cell* be the cell covering slot (x, y) .
9. If *current cell* is a header cell
 1. Set *in header block* to true.
 2. Add *current cell* to *headers from current header block*.
 3. Let *blocked* be false.
 4. If Δx is 0

If there are any cells in the *opaque headers* list anchored with the same

x-coordinate as the *current cell*, and with the same width as *current cell*, then let *blocked* be true.

If the *current cell* is not a [column header](#), then let *blocked* be true.

If Δy is 0

If there are any cells in the *opaque headers* list anchored with the same *y*-coordinate as the *current cell*, and with the same height as *current cell*, then let *blocked* be true.

If the *current cell* is not a [row header](#), then let *blocked* be true.

5. If *blocked* is false, then add the *current cell* to the *headers list*.

If *current cell* is a data cell and *in header block* is true

Set *in header block* to false. Add all the cells in *headers from current header block* to the *opaque headers* list, and empty the *headers from current header block* list.

10. Return to the step labeled *loop*.

A header cell anchored at the slot with coordinate (x, y) with width *width* and height *height* is said to be a *column header* if any of the following conditions are true:

- The cell's [scope](#) attribute is in the [column](#) state, or
- The cell's [scope](#) attribute is in the [auto](#) state, and there are no data cells in any of the cells covering slots with *y*-coordinates $y \dots y + height - 1$.

A header cell anchored at the slot with coordinate (x, y) with width *width* and height *height* is said to be a *row header* if any of the following conditions are true:

- The cell's [scope](#) attribute is in the [row](#) state, or
- The cell's [scope](#) attribute is in the [auto](#) state, the cell is not a [column header](#), and there are no data cells in any of the cells covering slots with *x*-coordinates $x \dots x + width - 1$.

A header cell is said to be a *column group header* if its [scope](#) attribute is in the [column group](#) state.

A header cell is said to be a *row group header* if its [scope](#) attribute is in the [row group](#) state.

A cell is said to be an *empty cell* if it contains no elements and its [child text content](#), if any, consists only of [ASCII whitespace](#).

4.9.13 Examples

This section is non-normative.

The following shows how might one mark up the bottom part of table 45 of the *Smithsonian physical tables, Volume 71*:

Grade.	Yield Point.	Ultimate tensile strength	Per cent elong. 50.8mm or 2in.	Per cent reduct. area.
kg/mm ²	lb/in ²			
Hard	0.45 ultimate	56.2	80,000	15
				20
Medium	0.45 ultimate	49.2	70,000	18
				25
Soft	0.45 ultimate	42.2	60,000	22
				30

This table could look like this:

Specification values: **Steel, Castings, Ann. A.S.T.M. A27-16, Class B;*** P max. 0.06; S max. 0.05.

Grade.	Yield Point.	Ultimate tensile strength		Per cent elong. 50.8 mm or 2 in.	Per cent reduct. area.
		kg/mm ²	lb/in ²		
Hard. . .	0.45 ultimate	56.2	80,000	15	20
Medium .	0.45 ultimate	49.2	70,000	18	25
Soft . . .	0.45 ultimate	42.2	60,000	22	30

The following shows how one might mark up the gross margin table on page 46 of Apple, Inc's 10-K filing for fiscal year 2008:

```

<table>
  <thead>
    <tr>
      <th></th>
      <th>2008</th>
      <th>2007</th>
      <th>2006</th>
    </tr>
  <tbody>
    <tr>
      <th>Net sales</th>
      <td>$ 32,479</td>
      <td>$ 24,006</td>
      <td>$ 19,315</td>
    </tr>
    <tr>
      <th>Cost of sales</th>
      <td> 21,334</td>
      <td> 15,852</td>
      <td> 13,717</td>
    </tr>
    <tr>
      <th>Gross margin</th>
      <td>$ 11,145</td>
      <td>$ 8,154</td>
      <td>$ 5,598</td>
    </tr>
  <tfoot>
    <tr>
      <th>Gross margin percentage</th>
      <td>34.3%</td>
    </tr>
  </tfoot>
</tbody>
</table>

```

```

<td>34.0%
<td>29.0%
</table>

```

This table could look like this:

	2008	2007	2006
Net sales	\$ 32,479	\$ 24,006	\$ 19,315
Cost of sales	21,334	15,852	13,717
Gross margin	<u>\$ 11,145</u>	<u>\$ 8,154</u>	<u>\$ 5,598</u>
Gross margin percentage	34.3%	34.0%	29.0%

The following shows how one might mark up the operating expenses table from lower on the same page of that document:

```

<table>
<colgroup> <col>
<colgroup> <col> <col> <col>
<thead>
<tr> <th>2008 <th>2007 <th>2006
<tbody>
<tr> <th scope=rowgroup> Research and development
    <td> $ 1,109 <td> $ 782 <td> $ 712
<tr> <th scope=row> Percentage of net sales
    <td> 3.4% <td> 3.3% <td> 3.7%
<tbody>
<tr> <th scope=rowgroup> Selling, general, and administrative
    <td> $ 3,761 <td> $ 2,963 <td> $ 2,433
<tr> <th scope=row> Percentage of net sales
    <td> 11.6% <td> 12.3% <td> 12.6%
</table>

```

This table could look like this:

	2008	2007	2006
Research and development	\$ 1,109	\$ 782	\$ 712
Percentage of net sales	3.4%	3.3%	3.7%
Selling, general, and administrative	\$ 3,761	\$ 2,963	\$ 2,433
Percentage of net sales	11.6%	12.3%	12.6%

4.10 Forms



[Element#Forms](#)

Support in all current engines.

Firefox4+Safari4+Chrome61+

Opera52+Edge79+

Edge (Legacy)16+Internet Explorer10+

Firefox Android5+Safari iOS3.2+Chrome Android61+WebView Android61+Samsung Internet8.0+Opera Android47+

4.10.1 Introduction

This section is non-normative.

A form is a component of a web page that has form controls, such as text, buttons, checkboxes, range, or color picker controls. A user can interact with such a form, providing data that can then be sent to the server for further processing (e.g. returning the results of a search or calculation). No client-side scripting is needed in many cases, though an API is available so that scripts can augment the user experience or use forms for purposes other than submitting data to a server.

Writing a form consists of several steps, which can be performed in any order: writing the user interface, implementing the server-side processing, and configuring the user interface to communicate with the server.

4.10.1.1 Writing a form's user interface

This section is non-normative.

For the purposes of this brief introduction, we will create a pizza ordering form.

Any form starts with a [form](#) element, inside which are placed the controls. Most controls are represented by the [input](#) element, which by default provides a text control. To label a control, the [label](#) element is used; the label text and the control itself go inside the [label](#) element. Each part of a form is considered a [paragraph](#), and is typically separated from other parts using [p](#) elements. Putting this together, here is how one might ask for the customer's name:

```
<form>
  <p><label>Customer name: <input></label></p>
</form>
```

To let the user select the size of the pizza, we can use a set of radio buttons. Radio buttons also use the [input](#) element, this time with a [type](#) attribute with the value [radio](#). To make the radio buttons work as a group, they are given a common name using the [name](#) attribute. To group a batch of controls together, such as, in this case, the radio buttons, one can use the [fieldset](#) element. The title of such a group of controls is given by the first element in the [fieldset](#), which has to be a [legend](#) element.

```
<form>
  <p><label>Customer name: <input></label></p>
```

```

<fieldset>
  <legend> Pizza Size </legend>
  <p><label> <input type=radio name=size> Small </label></p>
  <p><label> <input type=radio name=size> Medium </label></p>
  <p><label> <input type=radio name=size> Large </label></p>
</fieldset>
</form>

```

Changes from the previous step are highlighted.

To pick toppings, we can use checkboxes. These use the [input](#) element with a [type](#) attribute with the value [checkbox](#):

```

<form>
  <p><label>Customer name: <input></label></p>
  <fieldset>
    <legend> Pizza Size </legend>
    <p><label> <input type=radio name=size> Small </label></p>
    <p><label> <input type=radio name=size> Medium </label></p>
    <p><label> <input type=radio name=size> Large </label></p>
  </fieldset>
  <fieldset>
    <legend> Pizza Toppings </legend>
    <p><label> <input type=checkbox> Bacon </label></p>
    <p><label> <input type=checkbox> Extra Cheese </label></p>
    <p><label> <input type=checkbox> Onion </label></p>
    <p><label> <input type=checkbox> Mushroom </label></p>
  </fieldset>
</form>

```

The pizzeria for which this form is being written is always making mistakes, so it needs a way to contact the customer. For this purpose, we can use form controls specifically for telephone numbers ([input](#) elements with their [type](#) attribute set to [tel](#)) and email addresses ([input](#) elements with their [type](#) attribute set to [email](#)):

```

<form>
  <p><label>Customer name: <input></label></p>
  <p><label>Telephone: <input type=tel></label></p>
  <p><label>Email address: <input type=email></label></p>
  <fieldset>
    <legend> Pizza Size </legend>
    <p><label> <input type=radio name=size> Small </label></p>
    <p><label> <input type=radio name=size> Medium </label></p>
    <p><label> <input type=radio name=size> Large </label></p>
  </fieldset>
  <fieldset>
    <legend> Pizza Toppings </legend>

```

```

<p><label> <input type=checkbox> Bacon </label></p>
<p><label> <input type=checkbox> Extra Cheese </label></p>
<p><label> <input type=checkbox> Onion </label></p>
<p><label> <input type=checkbox> Mushroom </label></p>
</fieldset>
</form>

```

We can use an [input](#) element with its [type](#) attribute set to [time](#) to ask for a delivery time. Many of these form controls have attributes to control exactly what values can be specified; in this case, three attributes of particular interest are [min](#), [max](#), and [step](#). These set the minimum time, the maximum time, and the interval between allowed values (in seconds). This pizzeria only delivers between 11am and 9pm, and doesn't promise anything better than 15 minute increments, which we can mark up as follows:

```

<form>
  <p><label>Customer name: <input></label></p>
  <p><label>Telephone: <input type=tel></label></p>
  <p><label>Email address: <input type=email></label></p>
  <fieldset>
    <legend> Pizza Size </legend>
    <p><label> <input type=radio name=size> Small </label></p>
    <p><label> <input type=radio name=size> Medium </label></p>
    <p><label> <input type=radio name=size> Large </label></p>
  </fieldset>
  <fieldset>
    <legend> Pizza Toppings </legend>
    <p><label> <input type=checkbox> Bacon </label></p>
    <p><label> <input type=checkbox> Extra Cheese </label></p>
    <p><label> <input type=checkbox> Onion </label></p>
    <p><label> <input type=checkbox> Mushroom </label></p>
  </fieldset>
  <p><b>Preferred delivery time:</b> <input type=time min="11:00" max="21:00" ></p>
</form>

```

The [textarea](#) element can be used to provide a multiline text control. In this instance, we are going to use it to provide a space for the customer to give delivery instructions:

```

<form>
  <p><label>Customer name: <input></label></p>
  <p><label>Telephone: <input type=tel></label></p>
  <p><label>Email address: <input type=email></label></p>
  <fieldset>
    <legend> Pizza Size </legend>
    <p><label> <input type=radio name=size> Small </label></p>
    <p><label> <input type=radio name=size> Medium </label></p>
    <p><label> <input type=radio name=size> Large </label></p>
  </fieldset>

```

```

<fieldset>
  <legend> Pizza Toppings </legend>
  <p><label> <input type=checkbox> Bacon </label></p>
  <p><label> <input type=checkbox> Extra Cheese </label></p>
  <p><label> <input type=checkbox> Onion </label></p>
  <p><label> <input type=checkbox> Mushroom </label></p>
</fieldset>
<p><label>Preferred delivery time: <input type=time min="11:00" max="21:00" ></label></p>
<p><b>Delivery instructions:</b> <textarea></textarea></label></p>
</form>

```

Finally, to make the form submittable we use the [button](#) element:

```

<form>
<p><label>Customer name: <input></label></p>
<p><label>Telephone: <input type=tel></label></p>
<p><label>Email address: <input type=email></label></p>
<fieldset>
  <legend> Pizza Size </legend>
  <p><label> <input type=radio name=size> Small </label></p>
  <p><label> <input type=radio name=size> Medium </label></p>
  <p><label> <input type=radio name=size> Large </label></p>
</fieldset>
<fieldset>
  <legend> Pizza Toppings </legend>
  <p><label> <input type=checkbox> Bacon </label></p>
  <p><label> <input type=checkbox> Extra Cheese </label></p>
  <p><label> <input type=checkbox> Onion </label></p>
  <p><label> <input type=checkbox> Mushroom </label></p>
</fieldset>
<p><label>Preferred delivery time: <input type=time min="11:00" max="21:00" ></label></p>
<p><label>Delivery instructions: <textarea></textarea></label></p>
<p><b>Submit order</b></p>
</form>

```

4.10.1.2 Implementing the server-side processing for a form

This section is non-normative.

The exact details for writing a server-side processor are out of scope for this specification. For the purposes of this introduction, we will assume that the script at <https://pizza.example.com/order.cgi> is configured to accept submissions using the [application/x-www-form-urlencoded](#) format, expecting the following parameters sent in an HTTP POST body:

custname

Customer's name

custtel

Customer's telephone number

custemail

Customer's email address

size

The pizza size, either **small**, **medium**, or **large**

topping

A topping, specified once for each selected topping, with the allowed values being **bacon**, **cheese**, **onion**, and **mushroom**

delivery

The requested delivery time

comments

The delivery instructions

4.10.1.3 Configuring a form to communicate with a server

This section is non-normative.

Form submissions are exposed to servers in a variety of ways, most commonly as HTTP GET or POST requests. To specify the exact method used, the [method](#) attribute is specified on the [form](#) element. This doesn't specify how the form data is encoded, though; to specify that, you use the [enctype](#) attribute. You also have to specify the [URL](#) of the service that will handle the submitted data, using the [action](#) attribute.

For each form control you want submitted, you then have to give a name that will be used to refer to the data in the submission. We already specified the name for the group of radio buttons; the same attribute ([name](#)) also specifies the submission name. Radio buttons can be distinguished from each other in the submission by giving them different values, using the [value](#) attribute.

Multiple controls can have the same name; for example, here we give all the checkboxes the same name, and the server distinguishes which checkbox was checked by seeing which values are submitted with that name — like the radio buttons, they are also given unique values with the [value](#) attribute.

Given the settings in the previous section, this all becomes:

```
<form method="post"
      enctype="application/x-www-form-urlencoded"
      action="https://pizza.example.com/order.cgi">
<p><label>Customer name: <input name="custname"></label></p>
<p><label>Telephone: <input type=tel name="custtel"></label></p>
```

```

<p><label>Email address: <input type=email name="custemail"></label></p>
<fieldset>
  <legend> Pizza Size </legend>
  <p><label> <input type=radio name=size value="small"> Small </label></p>
  <p><label> <input type=radio name=size value="medium"> Medium </label></p>
  <p><label> <input type=radio name=size value="large"> Large </label></p>
</fieldset>
<fieldset>
  <legend> Pizza Toppings </legend>
  <p><label> <input type=checkbox name="topping" value="bacon"> Bacon </label>
  <p><label> <input type=checkbox name="topping" value="cheese"> Extra Cheese
  <p><label> <input type=checkbox name="topping" value="onion"> Onion </label>
  <p><label> <input type=checkbox name="topping" value="mushroom"> Mushroom </label>
</fieldset>
<p><label>Preferred delivery time: <input type=time min="11:00" max="21:00" ></label>
<p><label>Delivery instructions: <textarea name="comments"></textarea></label>
<p><button>Submit order</button></p>
</form>

```

There is no particular significance to the way some of the attributes have their values quoted and others don't. The HTML syntax allows a variety of equally valid ways to specify attributes, as discussed [in the syntax section](#).

For example, if the customer entered "Denise Lawrence" as their name, "555-321-8642" as their telephone number, did not specify an email address, asked for a medium-sized pizza, selected the Extra Cheese and Mushroom toppings, entered a delivery time of 7pm, and left the delivery instructions text control blank, the user agent would submit the following to the online web service:

`custname=Denise+Lawrence&custtel=555-321-8642&custemail=&size=medium&topping=cheese,mushroom&delivery_time=19:00&instructions=&`

4.10.1.4 Client-side form validation



[Form_validation](#)

Support in all current engines.

Firefox 4+ | Safari 5+ | Chrome 4+

Opera ≤ 12.1+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 10+

Firefox | Android 4+ | Safari iOS 4+ | Chrome | Android 18+ | WebView | Android ≤ 37+ | Samsung Internet 1.0+ | Opera Android ≤ 12.1+

This section is non-normative.

Forms can be annotated in such a way that the user agent will check the user's input before the form is submitted. The server still has to verify the input is valid (since hostile users can easily bypass the form validation), but it allows the user to avoid the wait incurred by having the server be the sole checker of the user's input.

The simplest annotation is the **required** attribute, which can be specified on **input** elements to indicate that the form is not to be submitted until a value is given. By adding this attribute to the customer name, pizza size, and delivery time fields, we allow the user agent to notify the user when the user submits the form without filling in those fields:

```
<form method="post"
      enctype="application/x-www-form-urlencoded"
      action="https://pizza.example.com/order.cgi">
  <p><label>Customer name: <input name="custname" required></label></p>
  <p><label>Telephone: <input type=tel name="custtel"></label></p>
  <p><label>Email address: <input type=email name="custemail"></label></p>
  <fieldset>
    <legend> Pizza Size </legend>
    <p><label> <input type=radio name=size required value="small"> Small </label>
    <p><label> <input type=radio name=size required value="medium"> Medium </label>
    <p><label> <input type=radio name=size required value="large"> Large </label>
  </fieldset>
  <fieldset>
    <legend> Pizza Toppings </legend>
    <p><label> <input type=checkbox name="topping" value="bacon"> Bacon </label>
    <p><label> <input type=checkbox name="topping" value="cheese"> Extra Cheese
    <p><label> <input type=checkbox name="topping" value="onion"> Onion </label>
    <p><label> <input type=checkbox name="topping" value="mushroom"> Mushroom </label>
  </fieldset>
  <p><label>Preferred delivery time: <input type=time min="11:00" max="21:00" ></label>
  <p><label>Delivery instructions: <textarea name="comments"></textarea></label>
  <p><button>Submit order</button></p>
</form>
```

It is also possible to limit the length of the input, using the **maxlength** attribute. By adding this to the **textarea** element, we can limit users to 1000 characters, preventing them from writing huge essays to the busy delivery drivers instead of staying focused and to the point:

```
<form method="post"
      enctype="application/x-www-form-urlencoded"
      action="https://pizza.example.com/order.cgi">
  <p><label>Customer name: <input name="custname" required></label></p>
  <p><label>Telephone: <input type=tel name="custtel"></label></p>
  <p><label>Email address: <input type=email name="custemail"></label></p>
  <fieldset>
    <legend> Pizza Size </legend>
    <p><label> <input type=radio name=size required value="small"> Small </label>
```

```

<p><label> <input type=radio name=size required value="medium"> Medium </label>
<p><label> <input type=radio name=size required value="large"> Large </label>
</fieldset>
<fieldset>
  <legend> Pizza Toppings </legend>
  <p><label> <input type=checkbox name="topping" value="bacon"> Bacon </label>
  <p><label> <input type=checkbox name="topping" value="cheese"> Extra Cheese
  <p><label> <input type=checkbox name="topping" value="onion"> Onion </label>
  <p><label> <input type=checkbox name="topping" value="mushroom"> Mushroom </label>
</fieldset>
<p><label>Preferred delivery time: <input type=time min="11:00" max="21:00" >
<p><label>Delivery instructions: <textarea name="comments" maxlength=1000></p>
<p><button>Submit order</button></p>
</form>

```

When a form is submitted, **[invalid](#)** events are fired at each form control that is invalid. This can be useful for displaying a summary of the problems with the form, since typically the browser itself will only report one problem at a time.

4.10.1.5 Enabling client-side automatic filling of form controls

This section is non-normative.

Some browsers attempt to aid the user by automatically filling form controls rather than having the user reenter their information each time. For example, a field asking for the user's telephone number can be automatically filled with the user's phone number.

To help the user agent with this, the **[autocomplete](#)** attribute can be used to describe the field's purpose. In the case of this form, we have three fields that can be usefully annotated in this way: the information about who the pizza is to be delivered to. Adding this information looks like this:

```

<form method="post"
      enctype="application/x-www-form-urlencoded"
      action="https://pizza.example.com/order.cgi">
<p><label>Customer name: <input name="custname" required autocomplete="shipping" type="text">
<p><label>Telephone: <input type=tel name="custtel" autocomplete="shipping" type="text">
<p><label>Email address: <input type=email name="custemail" autocomplete="shipping" type="text">
<fieldset>
  <legend> Pizza Size </legend>
  <p><label> <input type=radio name=size required value="small"> Small </label>
  <p><label> <input type=radio name=size required value="medium"> Medium </label>
  <p><label> <input type=radio name=size required value="large"> Large </label>
</fieldset>
<fieldset>
  <legend> Pizza Toppings </legend>
  <p><label> <input type=checkbox name="topping" value="bacon"> Bacon </label>

```

```

<p><label> <input type=checkbox name="topping" value="cheese"> Extra Cheese
<p><label> <input type=checkbox name="topping" value="onion"> Onion </label>
<p><label> <input type=checkbox name="topping" value="mushroom"> Mushroom </label>
</fieldset>
<p><label>Preferred delivery time: <input type=time min="11:00" max="21:00" >
<p><label>Delivery instructions: <textarea name="comments" maxlength=1000></p>
<p><button>Submit order</button></p>
</form>

```

4.10.1.6 Improving the user experience on mobile devices

This section is non-normative.

Some devices, in particular those with virtual keyboards can provide the user with multiple input modalities. For example, when typing in a credit card number the user may wish to only see keys for digits 0-9, while when typing in their name they may wish to see a form field that by default capitalizes each word.

Using the [inputmode](#) attribute we can select appropriate input modalities:

```

<form method="post"
      enctype="application/x-www-form-urlencoded"
      action="https://pizza.example.com/order.cgi">
<p><label>Customer name: <input name="custname" required autocomplete="shipping" type="text">
<p><label>Telephone: <input type="tel" name="custtel" autocomplete="shipping" type="text">
<p><label>Buzzer code: <input name="custbuzz" inputmode="numeric"></label></p>
<p><label>Email address: <input type="email" name="custemail" autocomplete="shipping" type="text">
<fieldset>
  <legend> Pizza Size </legend>
  <p><label> <input type="radio" name="size" required value="small"> Small </label>
  <p><label> <input type="radio" name="size" required value="medium"> Medium </label>
  <p><label> <input type="radio" name="size" required value="large"> Large </label>
</fieldset>
<fieldset>
  <legend> Pizza Toppings </legend>
  <p><label> <input type=checkbox name="topping" value="bacon"> Bacon </label>
  <p><label> <input type=checkbox name="topping" value="cheese"> Extra Cheese
  <p><label> <input type=checkbox name="topping" value="onion"> Onion </label>
  <p><label> <input type=checkbox name="topping" value="mushroom"> Mushroom </label>
</fieldset>
<p><label>Preferred delivery time: <input type=time min="11:00" max="21:00" >
<p><label>Delivery instructions: <textarea name="comments" maxlength=1000></p>
<p><button>Submit order</button></p>
</form>

```

4.10.1.7 The difference between the field type, the autofocus field name, and the input modality

This section is non-normative.

The [type](#), [autocomplete](#), and [inputmode](#) attributes can seem confusingly similar. For instance, in all three cases, the string "[email](#)" is a valid value. This section attempts to illustrate the difference between the three attributes and provides advice suggesting how to use them.

The [type](#) attribute on [input](#) elements decides what kind of control the user agent will use to expose the field. Choosing between different values of this attribute is the same choice as choosing whether to use an [input](#) element, a [textarea](#) element, a [select](#) element, etc.

The [autocomplete](#) attribute, in contrast, describes what the value that the user will enter actually represents. Choosing between different values of this attribute is the same choice as choosing what the label for the element will be.

First, consider telephone numbers. If a page is asking for a telephone number from the user, the right form control to use is [`<input type=tel>`](#). However, which [autocomplete](#) value to use depends on which phone number the page is asking for, whether they expect a telephone number in the international format or just the local format, and so forth.

For example, a page that forms part of a checkout process on an e-commerce site for a customer buying a gift to be shipped to a friend might need both the buyer's telephone number (in case of payment issues) and the friend's telephone number (in case of delivery issues). If the site expects international phone numbers (with the country code prefix), this could thus look like this:

```
<p><label>Your phone number: <input type=tel name=custtel autocomplete="billi<p><label>Recipient's phone number: <input type=tel name=shiptel autocomplete=<p>Please enter complete phone numbers including the country code prefix, as :
```

But if the site only supports British customers and recipients, it might instead look like this (notice the use of [tel-national](#) rather than [tel](#)):

```
<p><label>Your phone number: <input type=tel name=custtel autocomplete="billi<p><label>Recipient's phone number: <input type=tel name=shiptel autocomplete=<p>Please enter complete UK phone numbers, as in "(01632) 960 123".
```

Now, consider a person's preferred languages. The right [autocomplete](#) value is [language](#). However, there could be a number of different form controls used for the purpose: a text control ([`<input type=text>`](#)), a drop-down list ([`<select>`](#)), radio buttons ([`<input type=radio>`](#)), etc. It only depends on what kind of interface is desired.

Finally, consider names. If a page just wants one name from the user, then the relevant control is [`<input type=text>`](#). If the page is asking for the user's full name, then the relevant [autocomplete](#) value is [name](#).

```
<p><label>Japanese name: <input name="j" type="text" autocomplete="section-jp"
<label>Romanized name: <input name="e" type="text" autocomplete="section-en" n
```

In this example, the "section-*" keywords in the **autocomplete** attributes' values tell the user agent that the two fields expect *different* names. Without them, the user agent could automatically fill the second field with the value given in the first field when the user gave a value to the first field.

The "-jp" and "-en" parts of the keywords are opaque to the user agent; the user agent cannot guess, from those, that the two names are expected to be in Japanese and English respectively.

Separate from the choices regarding **type** and **autocomplete**, the **inputmode** attribute decides what kind of input modality (e.g., virtual keyboard) to use, when the control is a text control.

Consider credit card numbers. The appropriate input type is *not* **<input type=number>**, as explained below; it is instead **<input type=text>**. To encourage the user agent to use a numeric input modality anyway (e.g., a virtual keyboard displaying only digits), the page would use

```
<p><label>Credit card number:
    <input name="cc" type="text" inputmode="numeric" pattern="[0-9]*">
</label></p>
```

4.10.1.8 Date, time, and number formats

This section is non-normative.

In this pizza delivery example, the times are specified in the format "HH:MM": two digits for the hour, in 24-hour format, and two digits for the time. (Seconds could also be specified, though they are not necessary in this example.)

In some locales, however, times are often expressed differently when presented to users. For example, in the United States, it is still common to use the 12-hour clock with an am/pm indicator, as in "2pm". In France, it is common to separate the hours from the minutes using an "h" character, as in "14h00".

Similar issues exist with dates, with the added complication that even the order of the components is not always consistent — for example, in Cyprus the first of February 2003 would typically be written "1/2/03", while that same date in Japan would typically be written as "2003年02月01日" — and even with numbers, where locales differ, for example, in what punctuation is used as the decimal separator and the thousands separator.

It is therefore important to distinguish the time, date, and number formats used in HTML and in form submissions, which are always the formats defined in this specification (and based on the well-established ISO 8601 standard for computer-readable date and time formats), from the time, date, and number formats presented to the user by the browser and accepted as input

from the user by the browser.

The format used "on the wire", i.e., in HTML markup and in form submissions, is intended to be computer-readable and consistent irrespective of the user's locale. Dates, for instance, are always written in the format "YYYY-MM-DD", as in "2003-02-01". While some users might see this format, others might see it as "01.02.2003" or "February 1, 2003".

The time, date, or number given by the page in the wire format is then translated to the user's preferred presentation (based on user preferences or on the locale of the page itself), before being displayed to the user. Similarly, after the user inputs a time, date, or number using their preferred format, the user agent converts it back to the wire format before putting it in the DOM or submitting it.

This allows scripts in pages and on servers to process times, dates, and numbers in a consistent manner without needing to support dozens of different formats, while still supporting the users' needs.

See also the [implementation notes](#) regarding localization of form controls.

4.10.2 Categories

Mostly for historical reasons, elements in this section fall into several overlapping (but subtly different) categories in addition to the usual ones like [flow content](#), [phrasing content](#), and [interactive content](#).

A number of the elements are *form-associated elements*, which means they can have a [form owner](#).

- [button](#)
- [fieldset](#)
- [input](#)
- [object](#)
- [output](#)
- [select](#)
- [textarea](#)
- [img](#)
- [form-associated custom elements](#)

The [form-associated elements](#) fall into several subcategories:

Listed elements

Denotes elements that are listed in the [form.elements](#) and [fieldset.elements](#) APIs. These elements also have a [form](#) content attribute, and a matching [form](#) IDL attribute, that allow authors to specify an explicit [form owner](#).

- [button](#)

- [fieldset](#)
- [input](#)
- [object](#)
- [output](#)
- [select](#)
- [textarea](#)
- [form-associated custom elements](#)

Submittable elements

Denotes elements that can be used for [constructing the entry list](#) when a [form](#) element is submitted.

- [button](#)
- [input](#)
- [select](#)
- [textarea](#)
- [form-associated custom elements](#)

Some [submittable elements](#) can be, depending on their attributes, *buttons*. The prose below defines when an element is a button. Some buttons are specifically *submit buttons*.

Resettable elements

Denotes elements that can be affected when a [form](#) element is [reset](#).

- [input](#)
- [output](#)
- [select](#)
- [textarea](#)
- [form-associated custom elements](#)

Autocapitalize-inheriting elements

Denotes elements that inherit the [autocapitalize](#) attribute from their [form owner](#).

- [button](#)
- [fieldset](#)
- [input](#)
- [output](#)
- [select](#)
- [textarea](#)

Some elements, not all of them [form-associated](#), are categorized as *labelable elements*. These are elements that can be associated with a [label](#) element.

- [button](#)

- [input](#) (if the `type` attribute is *not* in the [Hidden](#) state)
- [meter](#)
- [output](#)
- [progress](#)
- [select](#)
- [textarea](#)
- [form-associated custom elements](#)

4.10.3 The **form** element



[Element/form](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLFormElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 8+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

[Categories:](#)

[Flow content](#).

[Palpable content](#).

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected.

[Content model:](#)

[Flow content](#), but with no [form](#) element descendants.

[Tag omission in text/html:](#)

Neither tag is omissible.

Content attributes:

Global attributes

accept-charset — Character encodings to use for form submission

action — URL to use for form submission

autocomplete — Default setting for autofill feature for controls in the form

enctype — Entry list encoding type to use for form submission

method — Variant to use for form submission

name — Name of form to use in the document.forms API

novalidate — Bypass form control validation for form submission

target — Browsing context for form submission

rel

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window,  
LegacyOverrideBuiltIns,  
LegacyUnenumerableNamedProperties]  
interface HTMLFormElement : HTMLElement {  
    [HTMLConstructor] constructor();  
  
    [CEReactions] attribute DOMString acceptCharset;  
    [CEReactions] attribute USVString action;  
    [CEReactions] attribute DOMString autocomplete;  
    [CEReactions] attribute DOMString enctype;  
    [CEReactions] attribute DOMString encoding;  
    [CEReactions] attribute DOMString method;  
    [CEReactions] attribute DOMString name;  
    [CEReactions] attribute boolean noValidate;  
    [CEReactions] attribute DOMString target;  
    [CEReactions] attribute DOMString rel;  
    [SameObject, PutForwards=value] readonly attribute DOMTokenList relList;  
  
    [SameObject] readonly attribute HTMLFormControlsCollection elements;  
    readonly attribute unsigned long length;  
    getter Element (unsigned long index);
```

```

    getter (RadioNodeList or Element) (DOMString name);

    undefined submit();
    undefined requestSubmit(optional HTMLElement? submitter = null);
    [CEReactions] undefined reset();
    boolean checkValidity();
    boolean reportValidity();
};


```

The [form](#) element [represents](#) a [hyperlink](#) that can be manipulated through a collection of [form-associated elements](#), some of which can represent editable values that can be submitted to a server for processing.

The [accept-charset](#) attribute gives the character encodings that are to be used for the submission. If specified, the value must be an [ASCII case-insensitive](#) match for "UTF-8".
[\[ENCODING\]](#)

The [name](#) attribute represents the [form](#)'s name within the [forms](#) collection. The value must not be the empty string, and the value must be unique amongst the [form](#) elements in the [forms](#) collection that it is in, if any.

The [autocomplete](#) attribute is an [enumerated attribute](#). The attribute has two states. The [on](#) keyword maps to the [on](#) state, and the [off](#) keyword maps to the [off](#) state. The attribute may also be omitted. The [missing value default](#) and the [invalid value default](#) are the [on](#) state. The [off](#) state indicates that by default, form controls in the form will have their [autofill field name](#) set to "[off](#)"; the [on](#) state indicates that by default, form controls in the form will have their [autofill field name](#) set to "[on](#)".

The [action](#), [enctype](#), [method](#), [novalidate](#), and [target](#) attributes are [attributes for form submission](#).

The [rel](#) attribute on [form](#) elements controls what kinds of links the elements create. The attribute's value must be a [unordered set of unique space-separated tokens](#). The [allowed keywords and their meanings](#) are defined in an earlier section.

[rel's supported tokens](#) are the keywords defined in [HTML link types](#) which are allowed on [form](#) elements, impact the processing model, and are supported by the user agent. The possible [supported tokens](#) are [noreferrer](#), [noopener](#), and [opener](#). [rel's supported tokens](#) must only include the tokens from this list that the user agent implements the processing model for.

[form.elements](#)



[HTMLFormElement/elements](#)

Support in all current engines.

Firefox 1+Safari 3+Chrome 1+

Opera 8+Edge 79+

Edge (Legacy) 12+Internet Explorer 5.5+

Firefox Android 4+Safari iOS 1+Chrome Android 18+WebView Android 1+Samsung Internet 1.0+Opera Android 10.1+

Returns an [HTMLFormControlsCollection](#) of the form controls in the form (excluding image buttons for historical reasons).

`form.length`

✓MDN

[HTMLFormElement/length](#)

Support in all current engines.

Firefox 1+Safari 3+Chrome 1+

Opera 12.1+Edge 79+

Edge (Legacy) 12+Internet Explorer 5.5+

Firefox Android 4+Safari iOS 1+Chrome Android 18+WebView Android 1+Samsung Internet 1.0+Opera Android 12.1+

Returns the number of form controls in the form (excluding image buttons for historical reasons).

`form[index]`

Returns the *index*th element in the form (excluding image buttons for historical reasons).

`form[name]`

Returns the form control (or, if there are several, a [RadioNodeList](#) of the form controls) in the form with the given [ID](#) or [name](#) (excluding image buttons for historical reasons); or, if there are none, returns the [img](#) element with the given ID.

Once an element has been referenced using a particular name, that name will continue being available as a way to reference that element in this method, even if the element's actual [ID](#) or [name](#) changes, for as long as the element remains in the [tree](#).

If there are multiple matching items, then a [RadioNodeList](#) object containing all those elements is returned.

`form.submit()`

✓MDN

[HTMLFormElement/submit](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Submits the form, bypassing [interactive constraint validation](#) and without firing a [submit](#) event.

`form.requestSubmit([submitter])`

MDN

[HTMLFormElement/requestSubmit](#)

Firefox 75+ Safari No Chrome 76+

Opera 63+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 79+ Safari iOS No Chrome Android 76+ WebView Android 76+ Samsung

Internet 12.0+ Opera Android 54+

Requests to submit the form. Unlike [submit\(\)](#), this method includes [interactive constraint validation](#) and firing a [submit](#) event, either of which can cancel submission.

The `submitter` argument can be used to point to a specific [submit button](#), whose [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), and [formtarget](#) attributes can impact submission. Additionally, the submitter will be included when [constructing the entry list](#) for submission; normally, buttons are excluded.

`form.reset()`

✓ MDN

[HTMLFormElement/reset](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 8+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Resets the form.

`form.checkValidity()`

Returns true if the form's controls are all valid; otherwise, returns false.

`form.reportValidity()`

Returns true if the form's controls are all valid; otherwise, returns false and informs the user.

The `autocomplete` IDL attribute must [reflect](#) the content attribute of the same name, [limited to only known values](#).



[HTMLFormElement/name](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The `name` and `rel` IDL attributes must [reflect](#) the content attribute of the same name.



[HTMLFormElement/acceptCharset](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The `acceptCharset` IDL attribute must [reflect](#) the [accept-charset](#) content attribute.

The `relList` IDL attribute must [reflect](#) the `rel` content attribute.

The `elements` IDL attribute must return an [HTMLFormControlsCollection](#) rooted at the `form` element's [root](#), whose filter matches [listed elements](#) whose [form owner](#) is the `form` element, with the exception of [input](#) elements whose `type` attribute is in the [Image Button](#)

state, which must, for historical reasons, be excluded from this particular collection.

The `length` IDL attribute must return the number of nodes represented by the `elements` collection.

The supported property indices at any instant are the indices supported by the object returned by the `elements` attribute at that instant.

To determine the value of an indexed property for a `form` element, the user agent must return the value returned by the `item` method on the `elements` collection, when invoked with the given index as its argument.

Each `form` element has a mapping of names to elements called the *past names map*. It is used to persist names of controls even when they change names.

The supported property names consist of the names obtained from the following algorithm, in the order obtained from this algorithm:

1. Let *sourced names* be an initially empty ordered list of tuples consisting of a string, an element, a source, where the source is either *id*, *name*, or *past*, and, if the source is *past*, an age.
2. For each listed element *candidate* whose form owner is the `form` element, with the exception of any `input` elements whose type attribute is in the Image Button state:
 1. If *candidate* has an id attribute, add an entry to *sourced names* with that id attribute's value as the string, *candidate* as the element, and *id* as the source.
 2. If *candidate* has a name attribute, add an entry to *sourced names* with that name attribute's value as the string, *candidate* as the element, and *name* as the source.
3. For each `img` element *candidate* whose form owner is the `form` element:
 1. If *candidate* has an id attribute, add an entry to *sourced names* with that id attribute's value as the string, *candidate* as the element, and *id* as the source.
 2. If *candidate* has a name attribute, add an entry to *sourced names* with that name attribute's value as the string, *candidate* as the element, and *name* as the source.
4. For each *entry past entry* in the past names map add an entry to *sourced names* with the *past entry*'s name as the string, *past entry*'s element as the element, *past* as the source, and the length of time *past entry* has been in the past names map as the age.
5. Sort *sourced names* by tree order of the element entry of each tuple, sorting entries with

the same element by putting entries whose source is *id* first, then entries whose source is *name*, and finally entries whose source is *past*, and sorting entries with the same element and source by their age, oldest first.

6. Remove any entries in *sourced names* that have the empty string as their name.
7. Remove any entries in *sourced names* that have the same name as an earlier entry in the map.
8. Return the list of names from *sourced names*, maintaining their relative order.

To [determine the value of a named property](#) *name* for a [form](#) element, the user agent must run the following steps:

1. Let *candidates* be a [live RadioNodeList](#) object containing all the [listed elements](#), whose [form owner](#) is the [form](#) element, that have either an [id](#) attribute or a [name](#) attribute equal to *name*, with the exception of [input](#) elements whose [type](#) attribute is in the [Image Button](#) state, in [tree order](#).
2. If *candidates* is empty, let *candidates* be a [live RadioNodeList](#) object containing all the [img](#) elements, whose [form owner](#) is the [form](#) element, that have either an [id](#) attribute or a [name](#) attribute equal to *name*, in [tree order](#).
3. If *candidates* is empty, *name* is the name of one of the entries in the [form](#) element's [past names map](#): return the object associated with *name* in that map.
4. If *candidates* contains more than one node, return *candidates*.
5. Otherwise, *candidates* contains exactly one node. Add a mapping from *name* to the node in *candidates* in the [form](#) element's [past names map](#), replacing the previous entry with the same name, if any.
6. Return the node in *candidates*.

If an element listed in a [form](#) element's [past names map](#) changes [form owner](#), then its entries must be removed from that map.

The [submit\(\)](#) method, when invoked, must [submit](#) the [form](#) element from the [form](#) element itself, with the *submitted from [submit\(\)](#) method* flag set.

The [requestSubmit\(submitter\)](#) method, when invoked, must run the following steps:

1. If *submitter* is not null, then:
 1. If *submitter* is not a [submit button](#), then throw a [TypeError](#).

2. If *submitter*'s [form owner](#) is not this [form](#) element, then throw a ["NotFoundError" DOMException](#).
2. Otherwise, set *submitter* to this [form](#) element.
3. [Submit](#) this [form](#) element, from *submitter*.

The [*reset\(\)*](#) method, when invoked, must run the following steps:

1. If the [form](#) element is marked as [locked for reset](#), then return.
2. Mark the [form](#) element as *locked for reset*.
3. [Reset](#) the [form](#) element.
4. Unmark the [form](#) element as [locked for reset](#).

If the [*checkValidity\(\)*](#) method is invoked, the user agent must [statically validate the constraints](#) of the [form](#) element, and return true if the constraint validation return a *positive* result, and false if it returned a *negative* result.

If the [*reportValidity\(\)*](#) method is invoked, the user agent must [interactively validate the constraints](#) of the [form](#) element, and return true if the constraint validation return a *positive* result, and false if it returned a *negative* result.

This example shows two search forms:

```
<form action="https://www.google.com/search" method="get">
  <label>Google: <input type="search" name="q"></label> <input type="submit" value="Search" />
</form>
<form action="https://www.bing.com/search" method="get">
  <label>Bing: <input type="search" name="q"></label> <input type="submit" value="Search" />
</form>
```

4.10.4 The **label** element



[Element/label](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes



[HTMLLabelElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content](#).

[Phrasing content](#).

[Interactive content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content](#), but with no descendant [labelable elements](#) unless it is the element's [labeled control](#), and no descendant [label](#) elements.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

for — Associate the label with form control

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLLabelElement : HTMLElement {
  [HTMLConstructor] constructor();
  readonly attribute HTMLFormElement? form;
```

```
[CEReactions] attribute DOMString htmlFor;  
readonly attribute HTMLElement? control;  
};
```

The [label](#) element [represents](#) a caption in a user interface. The caption can be associated with a specific form control, known as the [label](#) element's *labeled control*, either using the [for](#) attribute, or by putting the form control inside the [label](#) element itself.

Except where otherwise specified by the following rules, a [label](#) element has no [labeled control](#).

The [for](#) attribute may be specified to indicate a form control with which the caption is to be associated. If the attribute is specified, the attribute's value must be the [ID](#) of a [labelable element](#) in the same [tree](#) as the [label](#) element. If the attribute is specified and there is an element in the [tree](#) whose [ID](#) is equal to the value of the [for](#) attribute, and the first such element in [tree order](#) is a [labelable element](#), then that element is the [label](#) element's [labeled control](#).

If the [for](#) attribute is not specified, but the [label](#) element has a [labelable element](#) descendant, then the first such descendant in [tree order](#) is the [label](#) element's [labeled control](#).

The [label](#) element's exact default presentation and behavior, in particular what its [activation behavior](#) might be, if anything, should match the platform's label behavior. The [activation behavior](#) of a [label](#) element for events targeted at [interactive content](#) descendants of a [label](#) element, and any descendants of those [interactive content](#) descendants, must be to do nothing.

[Form-associated custom elements](#) are [labelable elements](#), so for user agents where the [label](#) element's [activation behavior](#) impacts the [labeled control](#), both built-in and custom elements will be impacted.

For example, on platforms where clicking a label activates the form control, clicking the [label](#) in the following snippet could trigger the user agent to [fire a click event](#) at the [input](#) element, as if the element itself had been triggered by the user:

```
<label><input type=checkbox name=lost> Lost</label>
```

Similarly, assuming `my-checkbox` was declared as a [form-associated custom element](#) (like in [this example](#)), then the code

```
<label><my-checkbox name=lost></my-checkbox> Lost</label>
```

would have the same behavior, [firing a click event](#) at the `my-checkbox` element.

On other platforms, the behavior in both cases might be just to focus the control, or to do nothing.

The following example shows three form controls each with a label, two of which have small

text showing the right format for users to use.

```
<p><label>Full name: <input name=fn> <small>Format: First Last</small></label>
<p><label>Age: <input name=age type=number min=0></label></p>
<p><label>Post code: <input name=pc> <small>Format: AB12 3CD</small></label></p>
```

label.control

✓MDN

[HTMLLabelElement/control](#)

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 6+

Opera 12.1+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns the form control that is associated with this element.

label.form

✓MDN

[HTMLLabelElement/form](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns the [form owner](#) of the form control that is associated with this element.

Returns null if there isn't one.

✓MDN

[HTMLLabelElement/htmlFor](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

The *htmlFor* IDL attribute must [reflect](#) the [for](#) content attribute.

The *control* IDL attribute must return the [label](#) element's [labeled control](#), if any, or null if there isn't one.

The *form* IDL attribute must run the following steps:

1. If the [label](#) element has no [labeled control](#), then return null.
2. If the [label](#) element's [labeled control](#) is not a [form-associated element](#), then return null.
3. Return the [label](#) element's [labeled control](#)'s [form owner](#) (which can still be null).

The [form](#) IDL attribute on the [label](#) element is different from the [form](#) IDL attribute on [listed form-associated elements](#), and the [label](#) element does not have a [form](#) content attribute.

[control.labels](#)



[HTMLButtonElement/labels](#)

Support in all current engines.

Firefox56+Safari5.1+Chrome6+

Opera12.1+Edge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android56+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

[HTMLInputElement/labels](#)

Support in all current engines.

Firefox56+Safari5+Chrome6+

Opera12.1+Edge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android56+Safari iOS4.2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

[HTMLMeterElement/labels](#)

Support in all current engines.

Firefox 56+ Safari 6+ Chrome 6+

Opera 12.1+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 56+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

[HTMLOutputElement/labels](#)

Support in all current engines.

Firefox 56+ Safari 5.1+ Chrome 9+

Opera 12.1+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 56+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

[HTMLProgressElement/labels](#)

Support in all current engines.

Firefox 56+ Safari 6+ Chrome 6+

Opera 12.1+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 56+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

[HTMLSelectElement/labels](#)

Support in all current engines.

Firefox 56+ Safari 5.1+ Chrome 6+

Opera 12.1+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 56+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

[HTMLTextAreaElement/labels](#)

Support in all current engines.

Firefox 56+ Safari 5.1+ Chrome 6+

Opera 12.1+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 56+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet1.0+Opera Android12.1+

Returns a [NodeList](#) of all the [label](#) elements that the form control is associated with.

[Labelable elements](#) and all [input](#) elements have a [live NodeList](#) object associated with them that represents the list of [label](#) elements, in [tree order](#), whose [labeled control](#) is the element in question. The [labels](#) IDL attribute of [labelable elements](#) that are not [form-associated custom elements](#), and the [labels](#) IDL attribute of [input](#) elements, on getting, must return that [NodeList](#) object, and that same value must always be returned, unless this element is an [input](#) element whose [type](#) attribute is in the [Hidden](#) state, in which case it must instead return null.

MDN

[ElementInternals/labels](#)

Firefox 95+ Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung

Internet 12.0+ Opera Android 55+

[Form-associated custom elements](#) don't have a [labels](#) IDL attribute. Instead, their [ElementInternals](#) object has a [labels](#) IDL attribute. On getting, it must throw a ["NotSupportedError" DOMException](#) if the [target element](#) is not a [form-associated custom element](#). Otherwise, it must return that [NodeList](#) object, and that same value must always be returned.

This (non-conforming) example shows what happens to the [NodeList](#) and what [labels](#) returns when an [input](#) element has its [type](#) attribute changed.

```
<!doctype html>
<p><label><input></label></p>
<script>
  const input = document.querySelector('input');
  const labels = input.labels;
  console.assert(labels.length === 1);

  input.type = 'hidden';
  console.assert(labels.length === 0); // the input is no longer the label's label
  console.assert(input.labels === null);

  input.type = 'checkbox';
  console.assert(labels.length === 1); // the input is once again the label's label
  console.assert(input.labels === labels); // same value as returned originally
</script>
```

4.10.5 The ***input*** element

✓MDN

[Element/input](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS 1+ Chrome Android Yes WebView Android 1+ Samsung Internet Yes Opera Android Yes

[Element/input](#)

✓MDN

[HTMLInputElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 8+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Categories:

Flow content.

Phrasing content.

If the [type](#) attribute is *not* in the [Hidden](#) state: [Interactive content](#).

If the [type](#) attribute is *not* in the [Hidden](#) state: [Listed](#), [labelable](#), [submittable](#), [resettable](#), and [autocapitalize-inheriting form-associated element](#).

If the [type](#) attribute is in the [Hidden](#) state: [Listed](#), [submittable](#), [resettable](#), and [autocapitalize-inheriting form-associated element](#).

If the [type](#) attribute is *not* in the [Hidden](#) state: [Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Nothing.](#)

Tag omission in text/html:

No end tag.

Content attributes:

Global attributes

accept — Hint for expected file type in file upload controls

alt — Replacement text for use when images are not available

autocomplete — Hint for form autofill feature

checked — Whether the control is checked

dirname — Name of form control to use for sending the element's directionality in form submission

disabled — Whether the form control is disabled

form — Associates the element with a form element

formaction — URL to use for form submission

formenctype — Entry list encoding type to use for form submission

formmethod — Variant to use for form submission

formnovalidate — Bypass form control validation for form submission

formtarget — Browsing context for form submission

height — Vertical dimension

list — List of autocomplete options

max — Maximum value

maxlength — Maximum length of value

min — Minimum value

minlength — Minimum length of value

multiple — Whether to allow multiple values

name — Name of the element to use for form submission and in the form.elements API

pattern — Pattern to be matched by the form control's value

placeholder — User-visible label to be placed within the form control

[readonly](#) — Whether to allow the value to be edited by the user

[required](#) — Whether the control is required for [form submission](#)

[size](#) — Size of the control

[src](#) — Address of the resource

[step](#) — Granularity to be matched by the form control's value

[type](#) — Type of form control

[value](#) — Value of the form control

[width](#) — Horizontal dimension

Also, the [title](#) attribute [has special semantics](#) on this element: Description of pattern (when used with [pattern](#) attribute).

[Accessibility considerations:](#)

[type](#) attribute in the [Hidden](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Text](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Search](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Telephone](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [URL](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Email](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Password](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Date](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Month](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Week](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Time](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Local Date and Time](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Number](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Range](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Color](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Checkbox](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Radio Button](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [File Upload](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Submit Button](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Image Button](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Reset Button](#) state: [for authors](#); [for implementers](#).

[type](#) attribute in the [Button](#) state: [for authors](#); [for implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLInputElement : HTMLElement {
    HTMLConstructor constructor();

    CEReactions attribute DOMString accept;
    CEReactions attribute DOMString alt;
    CEReactions attribute DOMString autocomplete;
    CEReactions attribute boolean defaultChecked;
    attribute boolean checked;
    CEReactions attribute DOMString dirName;
    CEReactions attribute boolean disabled;
    readonly attribute HTMLFormElement? form;
    attribute FileList? files;
    CEReactions attribute USVString formAction;
    CEReactions attribute DOMString formEnctype;
    CEReactions attribute DOMString formMethod;
    CEReactions attribute boolean formNoValidate;
    CEReactions attribute DOMString formTarget;
    CEReactions attribute unsigned long height;
    attribute boolean indeterminate;
    readonly attribute HTMLElement? list;
    CEReactions attribute DOMString max;
    CEReactions attribute long maxLength;
    CEReactions attribute DOMString min;
    CEReactions attribute long minLength;
    CEReactions attribute boolean multiple;
    CEReactions attribute DOMString name;
    CEReactions attribute DOMString pattern;
    CEReactions attribute DOMString placeholder;
    CEReactions attribute boolean readOnly;
    CEReactions attribute boolean required;
    CEReactions attribute unsigned long size;
```

```

[CEReactions] attribute USVString src;
[CEReactions] attribute DOMString step;
[CEReactions] attribute DOMString type;
[CEReactions] attribute DOMString defaultValue;
[CEReactions] attribute [LegacyNullToEmptyString] DOMString value;
attribute object? valueAsDate;
attribute unrestricted double valueAsNumber;
[CEReactions] attribute unsigned long width;

undefined stepUp(optional long n = 1);
undefined stepDown(optional long n = 1);

readonly attribute boolean willValidate;
readonly attribute ValidityState validity;
readonly attribute DOMString validationMessage;
boolean checkValidity();
boolean reportValidity();
undefined setCustomValidity(DOMString error);

readonly attribute NodeList? labels;

undefined select();
attribute unsigned long? selectionStart;
attribute unsigned long? selectionEnd;
attribute DOMString? selectionDirection;
undefined setRangeText(DOMString replacement);
undefined setRangeText(DOMString replacement, unsigned long start, unsig
undefined setSelectionRange(unsigned long start, unsigned long end, opti

// also has obsolete members
};

```

The input element represents a typed data field, usually with a form control to allow the user to edit the data.

The *type* attribute controls the data type (and associated control) of the element. It is an enumerated attribute. The following table lists the keywords and states for the attribute — the keywords in the left column map to the states in the cell in the second column on the same row as the keyword.

Keyword	State	Data type	Control type
<u>hidden</u>	<u>Hidden</u>	An arbitrary string	n/a
<u>text</u>	<u>Text</u>	Text with no line breaks	A text control
<u>search</u>	<u>Search</u>	Text with no line breaks	Search control
<u>tel</u>	<u>Telephone</u>	Text with no line breaks	A text control
<u>url</u>	<u>URL</u>	An absolute URL	A text control

Keyword	State	Data type	Control type
<code>email</code>	Email	An email address or list of email addresses	A text control
<code>password</code>	Password	Text with no line breaks (sensitive information)	A text control that obscures data entry
<code>date</code>	Date	A date (year, month, day) with no time zone	A date control
<code>month</code>	Month	A date consisting of a year and a month with no time zone	A month control
<code>week</code>	Week	A date consisting of a week-year number and a week number with no time zone	A week control
<code>time</code>	Time	A time (hour, minute, seconds, fractional seconds) with no time zone	A time control
<code>datetime</code> - <code>local</code>	Local Date and Time	A date and time (year, month, day, hour, minute, second, fraction of a second) with no time zone	A date and time control
<code>number</code>	Number	A numerical value	A text control or spinner control
<code>range</code>	Range	A numerical value, with the extra semantic that the exact value is not important	A slider control or similar
<code>color</code>	Color	An sRGB color with 8-bit red, green, and blue components	A color picker
<code>checkbox</code>	Checkbox	A set of zero or more values from a predefined list	A checkbox
<code>radio</code>	Radio Button	An enumerated value	A radio button
<code>file</code>	File Upload	Zero or more files each with a MIME type and optionally a filename	A label and a button
<code>submit</code>	Submit Button	An enumerated value, with the extra semantic that it must be the last value selected and initiates form submission	A button
<code>image</code>	Image Button	A coordinate, relative to a particular image's size, with the extra semantic that it must be the last value selected and initiates form submission	Either a clickable image, or a button
<code>reset</code>	Reset Button	n/a	A button
<code>button</code>	Button	n/a	A button

The [missing value default](#) and the [invalid value default](#) are the [Text](#) state.

Which of the [accept](#), [alt](#), [autocomplete](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), [src](#), [step](#), and [width](#) content attributes, the [checked](#), [files](#), [valueAsDate](#), [valueAsNumber](#), and [list](#) IDL attributes, the [select\(\)](#) method, the [selectionStart](#),

[selectionEnd](#), and [selectionDirection](#), IDL attributes, the [setRangeText\(\)](#) and [setSelectionRange\(\)](#) methods, the [stepUp\(\)](#) and [stepDown\(\)](#) methods, and the [input](#) and [change](#) events *apply* to an [input](#) element depends on the state of its [type](#) attribute. The subsections that define each type also clearly define in normative "bookkeeping" sections which of these feature apply, and which *do not apply*, to each type. The behavior of these features depends on whether they apply or not, as defined in their various sections (q.v. for [content](#) attributes, for [APIs](#), for [events](#)).

The following table is non-normative and summarizes which of those content attributes, IDL attributes, methods, and events [apply](#) to each state:

	<u>Hidden</u>	<u>Text</u> , <u>Search</u>	<u>URL</u> , <u>Telephone</u>	<u>Email</u>	<u>Password</u>	<u>Date</u> , <u>Month</u> , <u>Week</u> , <u>Time</u>	<u>Local</u>	<u>Date</u> , <u>Date</u> , <u>and</u> <u>Time</u>	<u>Number</u>	<u>Range</u>	<u>Color</u>	Che R Bu
<u>files</u>
<u>value</u>	default	value	value	value	value	value	value	value	value	value	value	defa
<u>valueAsDate</u>	Yes
<u>valueAsNumber</u>	Yes	Yes	Yes	Yes	Yes	.
<u>list</u>	.	Yes	Yes	Yes	.	.	Yes	Yes	Yes	Yes	Yes	.
<u>select()</u>	.	Yes	Yes	Yes†	Yes	Yes†	Yes†	Yes†	.	.	.	Yes†
<u>selectionStart</u>	.	Yes	Yes	.	Yes
<u>selectionEnd</u>	.	Yes	Yes	.	Yes
<u>selectionDirection</u>	.	Yes	Yes	.	Yes
<u>setRangeText()</u>	.	Yes	Yes	.	Yes
<u>setSelectionRange()</u>	.	Yes	Yes	.	Yes
<u>stepDown()</u>	Yes	Yes	Yes	Yes	.	.
<u>stepUp()</u>	Yes	Yes	Yes	Yes	.	.
Events												
<u>input</u> event	.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	.
<u>change</u> event	.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	.

† If the control has no selectable text, the select() method results in a no-op, with no "[InvalidStateError](#)" [DOMException](#).

Some states of the type attribute define a *value sanitization algorithm*.

Each input element has a value, which is exposed by the value IDL attribute. Some states define an *algorithm to convert a string to a number*, an *algorithm to convert a number to a string*, an *algorithm to convert a string to a Date object*, and an *algorithm to convert a Date object to a string*, which are used by max, min, step, valueAsDate, valueAsNumber, and stepUp().

An input element's dirty value flag must be set to true whenever the user interacts with the control in a way that changes the value. (It is also set to true when the value is programmatically changed, as described in the definition of the value IDL attribute.)

The value content attribute gives the default value of the input element. When the value content attribute is added, set, or removed, if the control's dirty value flag is false, the user agent must set the value of the element to the value of the value content attribute, if there is one, or the empty string otherwise, and then run the current value sanitization algorithm, if one is defined.

Each input element has a checkedness, which is exposed by the checked IDL attribute.

Each `input` element has a boolean *dirty checkedness flag*. When it is true, the element is said to have a *dirty checkedness*. The *dirty checkedness flag* must be initially set to false when the element is created, and must be set to true whenever the user interacts with the control in a way that changes the *checkedness*.

The `checked` content attribute is a *boolean attribute* that gives the default *checkedness* of the `input` element. When the `checked` content attribute is added, if the control does not have *dirty checkedness*, the user agent must set the *checkedness* of the element to true; when the `checked` content attribute is removed, if the control does not have *dirty checkedness*, the user agent must set the *checkedness* of the element to false.

The *reset algorithm* for `input` elements is to set the *dirty value flag* and *dirty checkedness flag* back to false, set the `value` of the element to the value of the `value` content attribute, if there is one, or the empty string otherwise, set the *checkedness* of the element to true if the element has a `checked` content attribute and false if it does not, empty the list of `selected files`, and then invoke the *value sanitization algorithm*, if the `type` attribute's current state defines one.

Each `input` element can be *mutable*. Except where otherwise specified, an `input` element is always *mutable*. Similarly, except where otherwise specified, the user agent should not allow the user to modify the element's `value` or *checkedness*.

When an `input` element is `disabled`, it is not *mutable*.

The `readonly` attribute can also in some cases (e.g. for the `Date` state, but not the `Checkbox` state) stop an `input` element from being *mutable*.

The *cloning steps* for `input` elements must propagate the `value`, *dirty value flag*, *checkedness*, and *dirty checkedness flag* from the node being cloned to the copy.

The *activation behavior* for `input` elements are these steps:

1. If this element is not *mutable* and is not in the `Checkbox` state and is not in the `Radio` state, then return.
2. Run this element's *input activation behavior*, if any, and do nothing otherwise.

The *legacy-pre-activation behavior* for `input` elements are these steps:

1. If this element's `type` attribute is in the `Checkbox state`, then set this element's *checkedness* to its opposite value (i.e. true if it is false, false if it is true) and set this element's `indeterminate` IDL attribute to false.
2. If this element's `type` attribute is in the `Radio Button state`, then get a reference to the element in this element's `radio button group` that has its *checkedness* set to true, if any, and then set this element's *checkedness* to true.

The *legacy-canceled-activation behavior* for `input` elements are these steps:

1. If the element's `type` attribute is in the [Checkbox state](#), then set the element's `checkedness` and the element's `ineterminate` IDL attribute back to the values they had before the [legacy-pre-activation behavior](#) was run.
 2. If this element's `type` attribute is in the [Radio Button state](#), then if the element to which a reference was obtained in the [legacy-pre-activation behavior](#), if any, is still in what is now this element's [radio button group](#), if it still has one, and if so, setting that element's `checkedness` to true; or else, if there was no such element, or that element is no longer in this element's [radio button group](#), or if this element no longer has a [radio button group](#), setting this element's `checkedness` to false.
-

When an `input` element is first created, the element's rendering and behavior must be set to the rendering and behavior defined for the `type` attribute's state, and the [value sanitization algorithm](#), if one is defined for the `type` attribute's state, must be invoked.

When an `input` element's `type` attribute changes state, the user agent must run the following steps:

1. If the previous state of the element's `type` attribute put the `value` IDL attribute in the `value` mode, and the element's `value` is not the empty string, and the new state of the element's `type` attribute puts the `value` IDL attribute in either the `default` mode or the `default/on` mode, then set the element's `value` content attribute to the element's `value`.
2. Otherwise, if the previous state of the element's `type` attribute put the `value` IDL attribute in any mode other than the `value` mode, and the new state of the element's `type` attribute puts the `value` IDL attribute in the `value` mode, then set the `value` of the element to the value of the `value` content attribute, if there is one, or the empty string otherwise, and then set the control's `dirty value flag` to false.
3. Otherwise, if the previous state of the element's `type` attribute put the `value` IDL attribute in any mode other than the `filename` mode, and the new state of the element's `type` attribute puts the `value` IDL attribute in the `filename` mode, then set the `value` of the element to the empty string.
4. Update the element's rendering and behavior to the new state's.
5. *Signal a type change* for the element. (The [Radio Button](#) state uses this, in particular.)
6. Invoke the [value sanitization algorithm](#), if one is defined for the `type` attribute's new state.
7. Let `previouslySelectable` be true if `setRangeText()` previously [applied](#) to the element, and false otherwise.
8. Let `nowSelectable` be true if `setRangeText()` now [applies](#) to the element, and false otherwise.

9. If `previouslySelectable` is false and `nowSelectable` is true, set the element's [text entry cursor position](#) to the beginning of the text control, and [set its selection direction](#) to "none".
-

The `name` attribute represents the element's name. The `dirname` attribute controls how the element's [directionality](#) is submitted. The `disabled` attribute is used to make the control non-interactive and to prevent its value from being submitted. The `form` attribute is used to explicitly associate the `input` element with its [form owner](#). The `autocomplete` attribute controls how the user agent provides autofill behavior.



[HTMLInputElement#indeterminate](#)

Support in all current engines.

Firefox 3.6+ Safari 3+ Chrome 1+

Opera ≤ 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android ≤ 12.1+

[caniuse.com table](#)

The `indeterminate` IDL attribute must initially be set to false. On getting, it must return the last value it was set to. On setting, it must be set to the new value. It has no effect except for changing the appearance of [checkbox](#) controls.



[HTMLInputElement/multiple](#)

Support in all current engines.

Firefox 3.6+ Safari 4+ Chrome 2+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

The `accept`, `alt`, `max`, `min`, `multiple`, `pattern`, `placeholder`, `required`, `size`, `src`, and `step` IDL attributes must [reflect](#) the respective content attributes of the same name. The `dirName` IDL attribute must [reflect](#) the `dirname` content attribute. The `readOnly` IDL attribute must [reflect](#) the `readonly` content attribute. The `defaultChecked` IDL attribute must [reflect](#) the `checked` content attribute. The `defaultValue` IDL attribute must [reflect](#) the

[value](#) content attribute.

The [type](#) IDL attribute must [reflect](#) the respective content attribute of the same name, [limited to only known values](#). The [maxLength](#) IDL attribute must [reflect](#) the [maxlength](#) content attribute, [limited to only non-negative numbers](#). The [minLength](#) IDL attribute must [reflect](#) the [minlength](#) content attribute, [limited to only non-negative numbers](#).

The IDL attributes [width](#) and [height](#) must return the rendered width and height of the image, in [CSS pixels](#), if an image is [being rendered](#), and is being rendered to a visual medium; or else the [intrinsic width and height](#) of the image, in [CSS pixels](#), if an image is [available](#) but not being rendered to a visual medium; or else 0, if no image is [available](#). When the [input](#) element's [type](#) attribute is not in the [Image Button](#) state, then no image is [available](#). [\[CSS\]](#)

On setting, they must act as if they [reflected](#) the respective content attributes of the same name.

The [willValidate](#), [validity](#), and [validationMessage](#) IDL attributes, and the [checkValidity\(\)](#), [reportValidity\(\)](#), and [setCustomValidity\(\)](#) methods, are part of the [constraint validation API](#). The [labels](#) IDL attribute provides a list of the element's [label](#)s. The [select\(\)](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods and IDL attributes expose the element's text selection. The [disabled](#), [form](#), and [name](#) IDL attributes are part of the element's forms API.

4.10.5.1 States of the [type](#) attribute

4.10.5.1.1 Hidden state ([type=hidden](#))

✓MDN

[Element/input/hidden](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 2+ Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Hidden](#) state, the rules in this section apply.

The [input](#) element [represents](#) a value that is not intended to be examined or manipulated by the user.

Constraint validation: If an [input](#) element's [type](#) attribute is in the [Hidden](#) state, it is [barred from constraint validation](#).

If the [name](#) attribute is present and has a value that is an [ASCII case-insensitive](#) match for "[_charset_](#)", then the element's [value](#) attribute must be omitted.

The [autocomplete](#) content attribute [applies](#) to this element.

The [value](#) IDL attribute [applies](#) to this element and is in mode [default](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [input](#) and [change](#) events [do not apply](#).

4.10.5.1.2 Text (**type=text**) state and Search state (**type=search**)



[Element/input/search](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 10.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Element/input/text](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an `input` element's `type` attribute is in the `Text` state or the `Search` state, the rules in this section apply.

The `input` element `represents` a one line plain text edit control for the element's `value`.

The difference between the `Text` state and the `Search` state is primarily stylistic: on platforms where search controls are distinguished from regular text controls, the `Search` state might result in an appearance consistent with the platform's search controls rather than appearing like a regular text control.

If the element is `mutable`, its `value` should be editable by the user. User agents must not allow users to insert U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters into the element's `value`.

If the element is `mutable`, the user agent should allow the user to change the writing direction of the element, setting it either to a left-to-right writing direction or a right-to-left writing direction. If the user does so, the user agent must then run the following steps:

1. Set the element's `dir` attribute to "`ltr`" if the user selected a left-to-right writing direction, and "`rtl`" if the user selected a right-to-left writing direction.
2. Queue an element task on the user interaction task source given the element to fire an event named `input` at the element, with the `bubbles` and `composed` attributes initialized to true.

The `value` attribute, if specified, must have a value that contains no U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters.

The `value sanitization algorithm` is as follows: Strip newlines from the `value`.

The following common `input` element content attributes, IDL attributes, and methods `apply` to the element: `autocomplete`, `dirname`, `list`, `maxlength`, `minlength`, `pattern`, `placeholder`, `readonly`, `required`, and `size` content attributes; `list`, `selectionStart`, `selectionEnd`, `selectionDirection`, and `value` IDL attributes; `select()`, `setRangeText()`, and `setSelectionRange()` methods.

The `value` IDL attribute is in mode `value`.

The `input` and `change` events `apply`.

The following content attributes must not be specified and `do not apply` to the element: `accept`, `alt`, `checked`, `formaction`, `formenctype`, `formmethod`, `formnovalidate`, `formtarget`, `height`, `max`, `min`, `multiple`, `src`, `step`, and `width`.

The following IDL attributes and methods `do not apply` to the element: `checked`, `files`, `valueAsDate`, and `valueAsNumber` IDL attributes; `stepDown()` and `stepUp()` methods.

4.10.5.1.3 Telephone state (`type=tel`)



[Element/input/tel](#)

Support in all current engines.

Firefox Yes Safari 4+ Chrome 3+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android Yes Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

When an `input` element's `type` attribute is in the [Telephone](#) state, the rules in this section apply.

The `input` element [represents](#) a control for editing a telephone number given in the element's [value](#).

If the element is [mutable](#), its [value](#) should be editable by the user. User agents may change the spacing and, with care, the punctuation of [values](#) that the user enters. User agents must not allow users to insert U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters into the element's [value](#).

The [value](#) attribute, if specified, must have a value that contains no U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters.

The [value sanitization algorithm](#) is as follows: [Strip newlines](#) from the [value](#).

Unlike the [URL](#) and [Email](#) types, the [Telephone](#) type does not enforce a particular syntax. This is intentional; in practice, telephone number fields tend to be free-form fields, because there are a wide variety of valid phone numbers. Systems that need to enforce a particular format are encouraged to use the [pattern](#) attribute or the [setCustomValidity\(\)](#) method to hook into the client-side validation mechanism.

The following common `input` element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [maxlength](#), [minlength](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), and [size](#) content attributes; [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), and [value](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The `input` and `change` events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [max](#), [min](#), [multiple](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [stepDown\(\)](#) and [stepUp\(\)](#) methods.

4.10.5.1.4 URL state (`type=url`)



[Element/input/url](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome 1+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [URL](#) state, the rules in this section apply.

The [input](#) element [represents](#) a control for editing a single [absolute URL](#) given in the element's [value](#).

If the element is [mutable](#), the user agent should allow the user to change the URL represented by its [value](#). User agents may allow the user to set the [value](#) to a string that is not a [valid absolute URL](#), but may also or instead automatically escape characters entered by the user so that the [value](#) is always a [valid absolute URL](#) (even if that isn't the actual value seen and edited by the user in the interface). User agents should allow the user to set the [value](#) to the empty string. User agents must not allow users to insert U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters into the [value](#).

The [value](#) attribute, if specified and not empty, must have a value that is a [valid URL potentially surrounded by spaces](#) that is also an [absolute URL](#).

The [value sanitization algorithm](#) is as follows: [Strip newlines](#) from the [value](#), then [strip leading and trailing ASCII whitespace](#) from the [value](#).

Constraint validation: While the [value](#) of the element is neither the empty string nor a [valid absolute URL](#), the element is [suffering from a type mismatch](#).

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [maxlength](#), [minlength](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), and [size](#) content attributes; [list](#), [selectionStart](#),

`selectionEnd`, `selectionDirection`, and `value` IDL attributes; `select()`, `setRangeText()`, and `setSelectionRange()` methods.

The `value` IDL attribute is in mode `value`.

The `input` and `change` events `apply`.

The following content attributes must not be specified and `do not apply` to the element: `accept`, `alt`, `checked`, `dirname`, `formaction`, `formenctype`, `formmethod`, `formnovalidate`, `formtarget`, `height`, `max`, `min`, `multiple`, `src`, `step`, and `width`.

The following IDL attributes and methods `do not apply` to the element: `checked`, `files`, `valueAsDate`, and `valueAsNumber` IDL attributes; `stepDown()` and `stepUp()` methods.

If a document contained the following markup:

```
<input type="url" name="location" list="urls">
<datalist id="urls">
  <option label="MIME: Format of Internet Message Bodies" value="https://tools.ietf.org/html/rfc2045#rfc.section.3.1">
  <option label="HTML" value="https://html.spec.whatwg.org/">
  <option label="DOM" value="https://dom.spec.whatwg.org/">
  <option label="Fullscreen" value="https://fullscreen.spec.whatwg.org/">
  <option label="Media Session" value="https://mediasession.spec.whatwg.org/">
  <option label="The Single UNIX Specification, Version 3" value="http://www.unix.com/whitepapers/unspec3.2.html#XSI-STREAMS">
</datalist>
```

...and the user had typed "spec.w", and the user agent had also found that the user had visited `https://url.spec.whatwg.org/#url-parsing` and `https://streams.spec.whatwg.org/` in the recent past, then the rendering might look like this:



The first four URLs in this sample consist of the four URLs in the author-specified list that match the text the user has entered, sorted in some `implementation-defined` manner (maybe by how frequently the user refers to those URLs). Note how the UA is using the knowledge that the values are URLs to allow the user to omit the scheme part and perform intelligent matching on the domain name.

The last two URLs (and probably many more, given the scrollbar's indications of more values

being available) are the matches from the user agent's session history data. This data is not made available to the page DOM. In this particular case, the UA has no titles to provide for those values.

4.10.5.1.5 *Email* state (`type=email`)



[Element/input/email](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome 5+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 3+ Chrome Android? WebView Android? Samsung Internet? Opera Android Yes

When an `input` element's `type` attribute is in the [Email](#) state, the rules in this section apply.

How the [Email](#) state operates depends on whether the `multiple` attribute is specified or not.

When the `multiple` attribute is not specified on the element

The `input` element [represents](#) a control for editing an email address given in the element's [value](#).

If the element is [mutable](#), the user agent should allow the user to change the email address represented by its [value](#). User agents may allow the user to set the [value](#) to a string that is not a [valid email address](#). The user agent should act in a manner consistent with expecting the user to provide a single email address. User agents should allow the user to set the [value](#) to the empty string. User agents must not allow users to insert U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters into the [value](#). User agents may transform the [value](#) for display and editing; in particular, user agents should convert punycode in the domain labels of the [value](#) to IDN in the display and vice versa.

Constraint validation: While the user interface is representing input that the user agent cannot convert to punycode, the control is [suffering from bad input](#).

The [value](#) attribute, if specified and not empty, must have a value that is a single [valid email address](#).

The [value sanitization algorithm](#) is as follows: [Strip newlines](#) from the [value](#), then [strip leading and trailing ASCII whitespace](#) from the [value](#).

Constraint validation: While the [value](#) of the element is neither the empty string nor a

single [valid email address](#), the element is [suffering from a type mismatch](#).

When the **multiple** attribute is specified on the element

The [input](#) element [represents](#) a control for adding, removing, and editing the email addresses given in the element's [values](#).

If the element is [mutable](#), the user agent should allow the user to add, remove, and edit the email addresses represented by its [values](#). User agents may allow the user to set any individual value in the list of [values](#) to a string that is not a [valid email address](#), but must not allow users to set any individual value to a string containing U+002C COMMA (,), U+000A LINE FEED (LF), or U+000D CARRIAGE RETURN (CR) characters. User agents should allow the user to remove all the addresses in the element's [values](#). User agents may transform the [values](#) for display and editing; in particular, user agents should convert punycode in the domain labels of the [value](#) to IDN in the display and vice versa.

Constraint validation: While the user interface describes a situation where an individual value contains a U+002C COMMA (,) or is representing input that the user agent cannot convert to punycode, the control is [suffering from bad input](#).

Whenever the user changes the element's [values](#), the user agent must run the following steps:

1. Let *latest values* be a copy of the element's [values](#).
2. [Strip leading and trailing ASCII whitespace](#) from each value in *latest values*.
3. Let the element's [value](#) be the result of concatenating all the values in *latest values*, separating each value from the next by a single U+002C COMMA character (,), maintaining the list's order.

The [value](#) attribute, if specified, must have a value that is a [valid email address list](#).

The [value sanitization algorithm](#) is as follows:

1. [Split on commas](#) the element's [value](#), [strip leading and trailing ASCII whitespace](#) from each resulting token, if any, and let the element's [values](#) be the (possibly empty) resulting list of (possibly empty) tokens, maintaining the original order.
2. Let the element's [value](#) be the result of concatenating the element's [values](#), separating each value from the next by a single U+002C COMMA character (,), maintaining the list's order.

Constraint validation: While the [value](#) of the element is not a [valid email address list](#), the element is [suffering from a type mismatch](#).

When the **multiple** attribute is set or removed, the user agent must run the [value sanitization algorithm](#).

A *valid email address* is a string that matches the `email` production of the following ABNF, the character set for which is Unicode. This ABNF implements the extensions described in RFC 1123. [ABNF] [RFC5322] [RFC1034] [RFC1123]

```
email      = 1*( atext / "." ) "@" label *( "." label )
label      = let-dig [ [ ldh-str ] let-dig ] ; limited to a length of 63
atext      = < as defined in RFC 5322 section 3.2.3 >
let-dig     = < as defined in RFC 1034 section 3.5 >
ldh-str     = < as defined in RFC 1034 section 3.5 >
```

This requirement is a [willful violation](#) of RFC 5322, which defines a syntax for email addresses that is simultaneously too strict (before the "@" character), too vague (after the "@" character), and too lax (allowing comments, whitespace characters, and quoted strings in manners unfamiliar to most users) to be of practical use here.

The following JavaScript- and Perl-compatible regular expression is an implementation of the above definition.

/^ [a-zA-Z0-9.!#\$%&'*+\`{|}~-]+@[a-zA-Z0-9](?:[a-zA-Z0-9-]{0,61}[a-zA-Z0-9].*)?\$/

A *valid email address list* is a [set of comma-separated tokens](#), where each token is itself a [valid email address](#). To obtain the list of tokens from a [valid email address list](#), an implementation must [split the string on commas](#).

The following common `input` element content attributes, IDL attributes, and methods [apply](#) to the element: `autocomplete`, `list`, `maxlength`, `minlength`, `multiple`, `pattern`, `placeholder`, `readonly`, `required`, and `size` content attributes; `list` and `value` IDL attributes; `select()` method.

The `value` IDL attribute is in mode `value`.

The `input` and `change` events apply.

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [max](#), [min](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#) and [stepUp\(\)](#) methods.

4.10.5.1.6 Password state (**type=password**)

[Element/input/password](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 2+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 2+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android? Samsung Internet Yes Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Password](#) state, the rules in this section apply.

The [input](#) element [represents](#) a one line plain text edit control for the element's [value](#). The user agent should obscure the value so that people other than the user cannot see it.

If the element is [mutable](#), its [value](#) should be editable by the user. User agents must not allow users to insert U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters into the [value](#).

The [value](#) attribute, if specified, must have a value that contains no U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters.

The [value sanitization algorithm](#) is as follows: Strip newlines from the [value](#).

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [maxlength](#), [minlength](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), and [size](#) content attributes; [selectionStart](#), [selectionEnd](#), [selectionDirection](#), and [value](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [min](#), [multiple](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [list](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [stepDown\(\)](#) and [stepUp\(\)](#) methods.

4.10.5.1.7 Date state (**type=date**)



[Element/input/date](#)

Support in all current engines.

Firefox 57+ Safari 14.1+ Chrome 20+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 57+ Safari iOS 5+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11+

When an [input](#) element's [type](#) attribute is in the [Date](#) state, the rules in this section apply.

The [input](#) element [represents](#) a control for setting the element's [value](#) to a string representing a specific [date](#).

If the element is [mutable](#), the user agent should allow the user to change the [date](#) represented by its [value](#), as obtained by [parsing a date](#) from it. User agents must not allow the user to set the [value](#) to a non-empty string that is not a [valid date string](#). If the user agent provides a user interface for selecting a [date](#), then the [value](#) must be set to a [valid date string](#) representing the user's selection. User agents should allow the user to set the [value](#) to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a [valid date string](#), the control is [suffering from bad input](#).

See the [introduction section](#) for a discussion of the difference between the input format and submission format for date, time, and number form controls, and the [implementation notes](#) regarding localization of form controls.

The [value](#) attribute, if specified and not empty, must have a value that is a [valid date string](#).

The [value sanitization algorithm](#) is as follows: If the [value](#) of the element is not a [valid date string](#), then set it to the empty string instead.

The [min](#) attribute, if specified, must have a value that is a [valid date string](#). The [max](#) attribute, if specified, must have a value that is a [valid date string](#).

The [step](#) attribute is expressed in days. The [step scale factor](#) is 86,400,000 (which converts the days to milliseconds, as used in the other algorithms). The [default step](#) is 1 day.

When the element is [suffering from a step mismatch](#), the user agent may round the element's [value](#) to the nearest [date](#) for which the element would not [suffer from a step mismatch](#).

The [algorithm to convert a string to a number](#), given a string [input](#), is as follows: If [parsing a](#)

[date](#) from *input* results in an error, then return an error; otherwise, return the number of milliseconds elapsed from midnight UTC on the morning of 1970-01-01 (the time represented by the value "1970-01-01T00:00:00.0Z") to midnight UTC on the morning of the parsed [date](#), ignoring leap seconds.

The [algorithm to convert a number to a string](#), given a number *input*, is as follows: Return a [valid date string](#) that represents the [date](#) that, in UTC, is current *input* milliseconds after midnight UTC on the morning of 1970-01-01 (the time represented by the value "1970-01-01T00:00:00.0Z").

The [algorithm to convert a string to a Date object](#), given a string *input*, is as follows: If [parsing a date](#) from *input* results in an error, then return an error; otherwise, return [a new Date object](#) representing midnight UTC on the morning of the parsed [date](#).

The [algorithm to convert a Date object to a string](#), given a [Date](#) object *input*, is as follows: Return a [valid date string](#) that represents the [date](#) current at the time represented by *input* in the UTC time zone.

The [Date](#) state (and other date- and time-related states described in subsequent sections) is not intended for the entry of values for which a precise date and time relative to the contemporary calendar cannot be established. For example, it would be inappropriate for the entry of times like "one millisecond after the big bang", "the early part of the Jurassic period", or "a winter around 250 BCE".

For the input of dates before the introduction of the Gregorian calendar, authors are encouraged to not use the [Date](#) state (and the other date- and time-related states described in subsequent sections), as user agents are not required to support converting dates and times from earlier periods to the Gregorian calendar, and asking users to do so manually puts an undue burden on users. (This is complicated by the manner in which the Gregorian calendar was phased in, which occurred at different times in different countries, ranging from partway through the 16th century all the way to early in the 20th.) Instead, authors are encouraged to provide fine-grained input controls using the [select](#) element and [input](#) elements with the [Number](#) state.

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [max](#), [min](#), [readonly](#), [required](#), and [step](#) content attributes; [list](#), [value](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [maxlength](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [size](#), [src](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [**checked**](#), [**selectionStart**](#), [**selectionEnd**](#), and [**selectionDirection**](#) IDL attributes; [**setRangeText\(\)**](#), and [**setSelectionRange\(\)**](#) methods.

4.10.5.1.8 Month state (**type=month**)

MDN

[Element/input/month](#)

Firefox No Safari No Chrome 20+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android No Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an [**input**](#) element's [**type**](#) attribute is in the [**Month**](#) state, the rules in this section apply.

The [**input**](#) element [represents](#) a control for setting the element's [**value**](#) to a string representing a specific [**month**](#).

If the element is [**mutable**](#), the user agent should allow the user to change the [**month**](#) represented by its [**value**](#), as obtained by [parsing a month](#) from it. User agents must not allow the user to set the [**value**](#) to a non-empty string that is not a [**valid month string**](#). If the user agent provides a user interface for selecting a [**month**](#), then the [**value**](#) must be set to a [**valid month string**](#) representing the user's selection. User agents should allow the user to set the [**value**](#) to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a [**valid month string**](#), the control is [suffering from bad input](#).

See the [introduction section](#) for a discussion of the difference between the input format and submission format for date, time, and number form controls, and the [implementation notes](#) regarding localization of form controls.

The [**value**](#) attribute, if specified and not empty, must have a value that is a [**valid month string**](#).

The [**value sanitization algorithm**](#) is as follows: If the [**value**](#) of the element is not a [**valid month string**](#), then set it to the empty string instead.

The [**min**](#) attribute, if specified, must have a value that is a [**valid month string**](#). The [**max**](#) attribute, if specified, must have a value that is a [**valid month string**](#).

The [**step**](#) attribute is expressed in months. The [**step scale factor**](#) is 1 (there is no conversion needed as the algorithms use months). The [**default step**](#) is 1 month.

When the element is [suffering from a step mismatch](#), the user agent may round the element's [value](#) to the nearest [month](#) for which the element would not [suffer from a step mismatch](#).

The [algorithm to convert a string to a number](#), given a string *input*, is as follows: If [parsing a month](#) from *input* results in an error, then return an error; otherwise, return the number of months between January 1970 and the parsed [month](#).

The [algorithm to convert a number to a string](#), given a number *input*, is as follows: Return a [valid month string](#) that represents the [month](#) that has *input* months between it and January 1970.

The [algorithm to convert a string to a Date object](#), given a string *input*, is as follows: If [parsing a month](#) from *input* results in an error, then return an error; otherwise, return a [new Date object](#) representing midnight UTC on the morning of the first day of the parsed [month](#).

The [algorithm to convert a Date object to a string](#), given a [Date](#) object *input*, is as follows: Return a [valid month string](#) that represents the [month](#) current at the time represented by *input* in the UTC time zone.

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [max](#), [min](#), [readonly](#), [required](#), and [step](#) content attributes; [list](#), [value](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [maxlength](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [size](#), [src](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), and [selectionDirection](#) IDL attributes; [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.

4.10.5.1.9 Week state (`type=week`)

MDN

[Element/input/week](#)

Firefox No Safari No Chrome 20+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Yes
Android Yes
Safari Yes
iOS No
Chrome Yes
Android Yes
WebView Yes
Android Yes
Samsung Internet Yes
Opera Android Yes

When an `input` element's `type` attribute is in the `Week` state, the rules in this section apply.

The `input` element `represents` a control for setting the element's `value` to a string representing a specific `week`.

If the element is `mutable`, the user agent should allow the user to change the `week` represented by its `value`, as obtained by `parsing a week` from it. User agents must not allow the user to set the `value` to a non-empty string that is not a `valid week string`. If the user agent provides a user interface for selecting a `week`, then the `value` must be set to a `valid week string` representing the user's selection. User agents should allow the user to set the `value` to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a `valid week string`, the control is `suffering from bad input`.

See the [introduction section](#) for a discussion of the difference between the input format and submission format for date, time, and number form controls, and the [implementation notes](#) regarding localization of form controls.

The `value` attribute, if specified and not empty, must have a value that is a `valid week string`.

The `value sanitization algorithm` is as follows: If the `value` of the element is not a `valid week string`, then set it to the empty string instead.

The `min` attribute, if specified, must have a value that is a `valid week string`. The `max` attribute, if specified, must have a value that is a `valid week string`.

The `step` attribute is expressed in weeks. The `step scale factor` is 604,800,000 (which converts the weeks to milliseconds, as used in the other algorithms). The `default step` is 1 week. The `default step base` is $-259,200,000$ (the start of week 1970-W01).

When the element is `suffering from a step mismatch`, the user agent may round the element's `value` to the nearest `week` for which the element would not `suffer from a step mismatch`.

The `algorithm to convert a string to a number`, given a string `input`, is as follows: If `parsing a week string` from `input` results in an error, then return an error; otherwise, return the number of milliseconds elapsed from midnight UTC on the morning of 1970-01-01 (the time represented by the value "1970-01-01T00:00:00.0Z") to midnight UTC on the morning of the Monday of the parsed `week`, ignoring leap seconds.

The `algorithm to convert a number to a string`, given a number `input`, is as follows: Return a `valid week string` that represents the `week` that, in UTC, is current `input` milliseconds after midnight UTC on the morning of 1970-01-01 (the time represented by the value "1970-01-01T00:00:00.0Z").

The `algorithm to convert a string to a Date object`, given a string `input`, is as follows: If `parsing`

a [week](#) from [input](#) results in an error, then return an error; otherwise, return a new [Date](#) object representing midnight UTC on the morning of the Monday of the parsed [week](#).

The [algorithm to convert a Date object to a string](#), given a [Date](#) object [input](#), is as follows:
Return a [valid week string](#) that represents the [week](#) current at the time represented by [input](#) in the UTC time zone.

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [max](#), [min](#), [readonly](#), [required](#), and [step](#) content attributes; [list](#), [value](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [maxlength](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [size](#), [src](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), and [selectionDirection](#) IDL attributes; [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.

4.10.5.1.10 Time state ([type=time](#))



[Element/input/time](#)

Support in all current engines.

Firefox 57+ Safari 14.1+ Chrome 20+

Opera 10+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 57+ Safari iOS Yes Chrome Android 25+ WebView Android Yes Samsung Internet 1.5+ Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Time](#) state, the rules in this section apply.

The [input](#) element [represents](#) a control for setting the element's [value](#) to a string representing a specific [time](#).

If the element is [mutable](#), the user agent should allow the user to change the [time](#) represented by its [value](#), as obtained by [parsing a time](#) from it. User agents must not allow the user to set

the [value](#) to a non-empty string that is not a [valid time string](#). If the user agent provides a user interface for selecting a [time](#), then the [value](#) must be set to a [valid time string](#) representing the user's selection. User agents should allow the user to set the [value](#) to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a [valid time string](#), the control is [suffering from bad input](#).

See the [introduction section](#) for a discussion of the difference between the input format and submission format for date, time, and number form controls, and the [implementation notes](#) regarding localization of form controls.

The [value](#) attribute, if specified and not empty, must have a value that is a [valid time string](#).

The [value sanitization algorithm](#) is as follows: If the [value](#) of the element is not a [valid time string](#), then set it to the empty string instead.

The form control [has a periodic domain](#).

The [min](#) attribute, if specified, must have a value that is a [valid time string](#). The [max](#) attribute, if specified, must have a value that is a [valid time string](#).

The [step](#) attribute is expressed in seconds. The [step scale factor](#) is 1000 (which converts the seconds to milliseconds, as used in the other algorithms). The [default step](#) is 60 seconds.

When the element is [suffering from a step mismatch](#), the user agent may round the element's [value](#) to the nearest [time](#) for which the element would not [suffer from a step mismatch](#).

The [algorithm to convert a string to a number](#), given a string *input*, is as follows: If [parsing a time](#) from *input* results in an error, then return an error; otherwise, return the number of milliseconds elapsed from midnight to the parsed [time](#) on a day with no time changes.

The [algorithm to convert a number to a string](#), given a number *input*, is as follows: Return a [valid time string](#) that represents the [time](#) that is *input* milliseconds after midnight on a day with no time changes.

The [algorithm to convert a string to a Date object](#), given a string *input*, is as follows: If [parsing a time](#) from *input* results in an error, then return an error; otherwise, return [a new Date object](#) representing the parsed [time](#) in UTC on 1970-01-01.

The [algorithm to convert a Date object to a string](#), given a [Date](#) object *input*, is as follows: Return a [valid time string](#) that represents the UTC [time](#) component that is represented by *input*.

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [max](#), [min](#), [readonly](#), [required](#), and [step](#) content attributes; [list](#), [value](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [maxlength](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [size](#), [src](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), and [selectionDirection](#) IDL attributes; [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.

4.10.5.1.11 Local Date and Time state (`type=datetime-local`)



[Element/input/datetime-local](#)

Support in all current engines.

Firefox 93+ Safari 14.1+ Chrome 20+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11+

When an [input](#) element's [type](#) attribute is in the [Local Date and Time](#) state, the rules in this section apply.

The [input](#) element [represents](#) a control for setting the element's [value](#) to a string representing a [local date and time](#), with no time-zone offset information.

If the element is [mutable](#), the user agent should allow the user to change the [date and time](#) represented by its [value](#), as obtained by [parsing a date and time](#) from it. User agents must not allow the user to set the [value](#) to a non-empty string that is not a [valid normalized local date and time string](#). If the user agent provides a user interface for selecting a [local date and time](#), then the [value](#) must be set to a [valid normalized local date and time string](#) representing the user's selection. User agents should allow the user to set the [value](#) to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a [valid normalized local date and time string](#), the control is [suffering from bad input](#).

See the [introduction section](#) for a discussion of the difference between the input format and submission format for date, time, and number form controls, and the [implementation notes](#) regarding localization of form controls.

The [value](#) attribute, if specified and not empty, must have a value that is a [valid local date and time string](#).

The [value sanitization algorithm](#) is as follows: If the [value](#) of the element is a [valid local date and time string](#), then set it to a [valid normalized local date and time string](#) representing the same date and time; otherwise, set it to the empty string instead.

The [min](#) attribute, if specified, must have a value that is a [valid local date and time string](#). The [max](#) attribute, if specified, must have a value that is a [valid local date and time string](#).

The [step](#) attribute is expressed in seconds. The [step scale factor](#) is 1000 (which converts the seconds to milliseconds, as used in the other algorithms). The [default step](#) is 60 seconds.

When the element is [suffering from a step mismatch](#), the user agent may round the element's value to the nearest [local date and time](#) for which the element would not [suffer from a step mismatch](#).

The [algorithm to convert a string to a number](#), given a string [input](#), is as follows: If [parsing a date and time](#) from [input](#) results in an error, then return an error; otherwise, return the number of milliseconds elapsed from midnight on the morning of 1970-01-01 (the time represented by the value "1970-01-01T00:00:00.0") to the parsed [local date and time](#), ignoring leap seconds.

The [algorithm to convert a number to a string](#), given a number [input](#), is as follows: Return a [valid normalized local date and time string](#) that represents the date and time that is [input](#) milliseconds after midnight on the morning of 1970-01-01 (the time represented by the value "1970-01-01T00:00:00.0").

See [the note on historical dates](#) in the [Date](#) state section.

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [max](#), [min](#), [readonly](#), [required](#), and [step](#) content attributes; [list](#), [value](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [maxlength](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [size](#), [src](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), and [valueAsDate](#) IDL attributes; [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.

The following example shows part of a flight booking application. The application uses an `input` element with its `type` attribute set to `datetime-local`, and it then interprets the given date and time in the time zone of the selected airport.

```
<fieldset>
  <legend>Destination</legend>
  <p><label>Airport: <input type="text" name="to" list="airports"></label></p>
  <p><label>Departure time: <input type="datetime-local" name="totime" step="3600"></label></p>
</fieldset>
<datalist id="airports">
  <option value="ATL" label="Atlanta">
  <option value="MEM" label="Memphis">
  <option value="LHR" label="London Heathrow">
  <option value="LAX" label="Los Angeles">
  <option value="FRA" label="Frankfurt">
</datalist>
```

4.10.5.1.12 Number state (`type=number`)



[Element/input/number](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an `input` element's `type` attribute is in the `Number` state, the rules in this section apply.

The `input` element `represents` a control for setting the element's `value` to a string representing a number.

If the element is `mutable`, the user agent should allow the user to change the number represented by its `value`, as obtained from applying the [rules for parsing floating-point number values](#) to it. User agents must not allow the user to set the `value` to a non-empty string that is not a [valid floating-point number](#). If the user agent provides a user interface for selecting a number, then the `value` must be set to the [best representation of the number representing the user's selection as a floating-point number](#). User agents should allow the user to set the `value` to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a [valid floating-point number](#), the control is [suffering from bad input](#).

This specification does not define what user interface user agents are to use; user agent vendors are encouraged to consider what would best serve their users' needs. For example, a user agent in Persian or Arabic markets might support Persian and Arabic numeric input (converting it to the format required for submission as described above). Similarly, a user agent designed for Romans might display the value in Roman numerals rather than in decimal; or (more realistically) a user agent designed for the French market might display the value with apostrophes between thousands and commas before the decimals, and allow the user to enter a value in that manner, internally converting it to the submission format described above.

The [value](#) attribute, if specified and not empty, must have a value that is a [valid floating-point number](#).

The [value sanitization algorithm](#) is as follows: If the [value](#) of the element is not a [valid floating-point number](#), then set it to the empty string instead.

The [min](#) attribute, if specified, must have a value that is a [valid floating-point number](#). The [max](#) attribute, if specified, must have a value that is a [valid floating-point number](#).

The [step scale factor](#) is 1. The [default step](#) is 1 (allowing only integers to be selected by the user, unless the [step base](#) has a non-integer value).

When the element is [suffering from a step mismatch](#), the user agent may round the element's [value](#) to the nearest number for which the element would not [suffer from a step mismatch](#). If there are two such numbers, user agents are encouraged to pick the one nearest positive infinity.

The [algorithm to convert a string to a number](#), given a string *input*, is as follows: If applying the [rules for parsing floating-point number values](#) to *input* results in an error, then return an error; otherwise, return the resulting number.

The [algorithm to convert a number to a string](#), given a number *input*, is as follows: Return a [valid floating-point number](#) that represents *input*.

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [max](#), [min](#), [placeholder](#), [readonly](#), [required](#), and [step](#) content attributes; [list](#), [value](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [maxlength](#), [minlength](#), [multiple](#), [pattern](#), [size](#), [src](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), and [valueAsDate](#) IDL attributes; [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.

Here is an example of using a numeric input control:

```
<label>How much do you want to charge? $<input type=number min=0 step=0.01 name="charge">
```

As described above, a user agent might support numeric input in the user's local format, converting it to the format required for submission as described above. This might include handling grouping separators (as in "872,000,000,000") and various decimal separators (such as "3,99" vs "3.99") or using local digits (such as those in Arabic, Devanagari, Persian, and Thai).

The **type=number** state is not appropriate for input that happens to only consist of numbers but isn't strictly speaking a number. For example, it would be inappropriate for credit card numbers or US postal codes. A simple way of determining whether to use **type=number** is to consider whether it would make sense for the input control to have a spinbox interface (e.g. with "up" and "down" arrows). Getting a credit card number wrong by 1 in the last digit isn't a minor mistake, it's as wrong as getting every digit incorrect. So it would not make sense for the user to select a credit card number using "up" and "down" buttons. When a spinbox interface is not appropriate, **type=text** is probably the right choice (possibly with an [inputmode](#) or [pattern](#) attribute).

4.10.5.1.13 Range state (**type=range**)



[Element/input/range](#)

Support in all current engines.

Firefox 23+ Safari 3.1+ Chrome 4+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 52+ Safari iOS 5+ Chrome Android 57+ WebView Android 4.4+ Samsung Internet 7.0+ Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Range](#) state, the rules in this section apply.

The [input](#) element [represents](#) a control for setting the element's [value](#) to a string representing a number, but with the caveat that the exact value is not important, letting UAs provide a simpler interface than they do for the [Number](#) state.

If the element is [mutable](#), the user agent should allow the user to change the number represented by its [value](#), as obtained from applying the [rules for parsing floating-point number values](#) to it. User agents must not allow the user to set the [value](#) to a string that is not a [valid](#)

[floating-point number](#). If the user agent provides a user interface for selecting a number, then the [value](#) must be set to a [best representation of the number representing the user's selection as a floating-point number](#). User agents must not allow the user to set the [value](#) to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a [valid floating-point number](#), the control is [suffering from bad input](#).

The [value](#) attribute, if specified, must have a value that is a [valid floating-point number](#).

The [value sanitization algorithm](#) is as follows: If the [value](#) of the element is not a [valid floating-point number](#), then set it to the [best representation, as a floating-point number](#), of the [default value](#).

The *default value* is the [minimum](#) plus half the difference between the [minimum](#) and the [maximum](#), unless the [maximum](#) is less than the [minimum](#), in which case the [default value](#) is the [minimum](#).

When the element is [suffering from an underflow](#), the user agent must set the element's [value](#) to the [best representation, as a floating-point number](#), of the [minimum](#).

When the element is [suffering from an overflow](#), if the [maximum](#) is not less than the [minimum](#), the user agent must set the element's [value](#) to a [valid floating-point number](#) that represents the [maximum](#).

When the element is [suffering from a step mismatch](#), the user agent must round the element's [value](#) to the nearest number for which the element would not [suffer from a step mismatch](#), and which is greater than or equal to the [minimum](#), and, if the [maximum](#) is not less than the [minimum](#), which is less than or equal to the [maximum](#), if there is a number that matches these constraints. If two numbers match these constraints, then user agents must use the one nearest to positive infinity.

For example, the markup

`<input type="range" min=0 max=100 step=20 value=50>` results in a range control whose initial value is 60.

Here is an example of a range control using an autocomplete list with the [list](#) attribute. This could be useful if there are values along the full range of the control that are especially important, such as preconfigured light levels or typical speed limits in a range control used as a speed control. The following markup fragment:

```
<input type="range" min="-100" max="100" value="0" step="10" name="power" list="powers">
<datalist id="powers">
<option value="0">
<option value="-30">
<option value="30">
  <option value="++50">
</datalist>
```

...with the following style sheet applied:

```
input { height: 75px; width: 49px; background: #D5CCBB; color: black; }
```

...might render as:



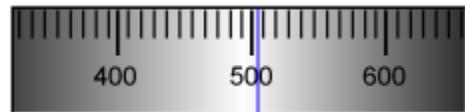
Note how the UA determined the orientation of the control from the ratio of the style-sheet-specified height and width properties. The colors were similarly derived from the style sheet. The tick marks, however, were derived from the markup. In particular, the `step` attribute has not affected the placement of tick marks, the UA deciding to only use the author-specified completion values and then adding longer tick marks at the extremes.

Note also how the invalid value `++50` was ignored.

For another example, consider the following markup fragment:

```
<input name=x type=range min=100 max=700 step=9.09090909 value=509.090909>
```

A user agent could display in a variety of ways, for instance:



Or, alternatively, for instance:



The user agent could pick which one to display based on the dimensions given in the style sheet. This would allow it to maintain the same resolution for the tick marks, despite the differences in width.

Finally, here is an example of a range control with two labeled values:

```
<input type="range" name="a" list="a-values">
<datalist id="a-values">
<option value="10" label="Low">
<option value="90" label="High">
</datalist>
```

With styles that make the control draw vertically, it might look as follows:



In this state, the range and step constraints are enforced even during user input, and there is no way to set the value to the empty string.

The [min](#) attribute, if specified, must have a value that is a [valid floating-point number](#). The [default minimum](#) is 0. The [max](#) attribute, if specified, must have a value that is a [valid floating-point number](#). The [default maximum](#) is 100.

The [step scale factor](#) is 1. The [default step](#) is 1 (allowing only integers, unless the [min](#) attribute has a non-integer value).

The [algorithm to convert a string to a number](#), given a string *input*, is as follows: If applying the [rules for parsing floating-point number values](#) to *input* results in an error, then return an error; otherwise, return the resulting number.

The [algorithm to convert a number to a string](#), given a number *input*, is as follows: Return the best representation, as a floating-point number, of *input*.

The following common [input](#) element content attributes, IDL attributes, and methods [apply](#) to the element: [autocomplete](#), [list](#), [max](#), [min](#), and [step](#) content attributes; [list](#), [value](#), and [valueAsNumber](#) IDL attributes; [stepDown\(\)](#) and [stepUp\(\)](#) methods.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [maxlength](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), [src](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), and [valueAsDate](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods.



[Element/input/color](#)

Support in all current engines.

Firefox 29+ Safari 12.1+ Chrome 20+

Opera 12+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 27+ Safari iOS 12.2+ Chrome Android 25+ WebView Android 4.4+ Samsung Internet 1.5+ Opera Android 12+

When an [input](#) element's [type](#) attribute is in the [Color](#) state, the rules in this section apply.

The [input](#) element [represents](#) a color well control, for setting the element's [value](#) to a string representing a [simple color](#).

In this state, there is always a color picked, and there is no way to set the value to the empty string.

If the element is [mutable](#), the user agent should allow the user to change the color represented by its [value](#), as obtained from applying the [rules for parsing simple color values](#) to it. User agents must not allow the user to set the [value](#) to a string that is not a [valid lowercase simple color](#). If the user agent provides a user interface for selecting a color, then the [value](#) must be set to the result of using the [rules for serializing simple color values](#) to the user's selection. User agents must not allow the user to set the [value](#) to the empty string.

Constraint validation: While the user interface describes input that the user agent cannot convert to a [valid lowercase simple color](#), the control is [suffering from bad input](#).

The [value](#) attribute, if specified and not empty, must have a value that is a [valid simple color](#).

The [value sanitization algorithm](#) is as follows: If the [value](#) of the element is a [valid simple color](#), then set it to the [value](#) of the element [converted to ASCII lowercase](#); otherwise, set it to the string "#000000".

The following common [input](#) element content attributes and IDL attributes [apply](#) to the element: [autocomplete](#) and [list](#) content attributes; [list](#) and [value](#) IDL attributes; [select\(\)](#) method.

The [value](#) IDL attribute is in mode [value](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element:

[accept](#), [alt](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#) and, [valueAsNumber](#) IDL attributes; [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

4.10.5.1.15 Checkbox state (`type=checkbox`)



[Element/input/checkbox](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Checkbox](#) state, the rules in this section apply.

The [input](#) element [represents](#) a two-state control that represents the element's [checkedness](#) state. If the element's [checkedness](#) state is true, the control represents a positive selection, and if it is false, a negative selection. If the element's [indeterminate](#) IDL attribute is set to true, then the control's selection should be obscured as if the control was in a third, indeterminate, state.

The control is never a true tri-state control, even if the element's [indeterminate](#) IDL attribute is set to true. The [indeterminate](#) IDL attribute only gives the appearance of a third state.

The [input activation behavior](#) is to run the following steps:

1. If the element is not [connected](#), then return.
2. [Fire an event](#) named [input](#) at the element with the [bubbles](#) and [composed](#) attributes initialized to true.
3. [Fire an event](#) named [change](#) at the element with the [bubbles](#) attribute initialized to true.

Constraint validation: If the element is [required](#) and its [checkedness](#) is false, then the element is suffering from being missing.

`input.indeterminate [= value]`

When set, overrides the rendering of [checkbox](#) controls so that the current value is not visible.

The following common [input](#) element content attributes and IDL attributes [apply](#) to the element: [checked](#), and [required](#) content attributes; [checked](#) and [value](#) IDL attributes.

The [value](#) IDL attribute is in mode [default/on](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [autocomplete](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [size](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [files](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

4.10.5.1.16 Radio Button state (`type=radio`)



[Element/input/radio](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Radio Button](#) state, the rules in this section apply.

The [input](#) element [represents](#) a control that, when used in conjunction with other [input](#) elements, forms a [radio button group](#) in which only one control can have its [checkedness](#) state set to true. If the element's [checkedness](#) state is true, the control represents the selected control in the group, and if it is false, it indicates a control in the group that is not selected.

The *radio button group* that contains an [input](#) element *a* also contains all the other [input](#) elements *b* that fulfill all of the following conditions:

- The [input](#) element *b*'s [type](#) attribute is in the [Radio Button](#) state.
- Either *a* and *b* have the same [form owner](#), or they both have no [form owner](#).
- Both *a* and *b* are in the same [tree](#).
- They both have a [name](#) attribute, their [name](#) attributes are not empty, and the value of *a*'s [name](#) attribute equals the value of *b*'s [name](#) attribute.

A [tree](#) must not contain an [input](#) element whose *radio button group* contains only that element.

When any of the following phenomena occur, if the element's [checkedness](#) state is true after the occurrence, the [checkedness](#) state of all the other elements in the same *radio button group* must be set to false:

- The element's [checkedness](#) state is set to true (for whatever reason).
- The element's [name](#) attribute is set, changed, or removed.
- The element's [form owner](#) changes.
- [A type change is signalled](#) for the element.

The [input activation behavior](#) is to run the following steps:

1. If the element is not [connected](#), then return.
2. [Fire an event](#) named [input](#) at the element with the [bubbles](#) and [composed](#) attributes initialized to true.
3. [Fire an event](#) named [change](#) at the element with the [bubbles](#) attribute initialized to true.

Constraint validation: If an element in the *radio button group* is [required](#), and all of the [input](#) elements in the *radio button group* have a [checkedness](#) that is false, then the element is [suffering from being missing](#).

The following example, for some reason, has specified that puppers are both [required](#) and [disabled](#):

```
<form>
  <p><label><input type="radio" name="dog-type" value="pupper" required disabled>
  <p><label><input type="radio" name="dog-type" value="doggo"> Doggo</label>
  <p><button>Make your choice</button>
</form>
```

If the user tries to submit this form without first selecting "Doggo", then *both* [input](#) elements will be [suffering from being missing](#), since an element in the *radio button group* is [required](#) (viz. the first element), and both of the elements in the radio button group have a false [checkedness](#).

On the other hand, if the user selects "Doggo" and then submits the form, then neither [input](#) element will be [suffering from being missing](#), since while one of them is [required](#), not all of them have a false [checkedness](#).

If none of the radio buttons in a [radio button group](#) are checked, then they will all be initially unchecked in the interface, until such time as one of them is checked (either by the user or by script).

The following common [input](#) element content attributes and IDL attributes [apply](#) to the element: [checked](#) and [required](#) content attributes; [checked](#) and [value](#) IDL attributes.

The [value](#) IDL attribute is in mode [default/on](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [autocomplete](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [size](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [files](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

4.10.5.1.17 File Upload state (`type=file`)



[Element/input/file](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11+

When an [input](#) element's [type](#) attribute is in the [File Upload](#) state, the rules in this section apply.

The [input](#) element [represents](#) a list of *selected files*, each file consisting of a filename, a file type, and a file body (the contents of the file).

Filenames must not contain [path components](#), even in the case that a user has selected an entire

directory hierarchy or multiple files with the same name from different directories. *Path components*, for the purposes of the [File Upload](#) state, are those parts of filenames that are separated by U+005C REVERSE SOLIDUS character (\) characters.

Unless the [**multiple**](#) attribute is set, there must be no more than one file in the list of [selected files](#).

The [input activation behavior](#) for such an element *element* is:

1. If the algorithm is invoked when *element*'s [relevant global object](#) does not have [transient activation](#), then return.
2. Run these steps [in parallel](#):
 1. Optionally, wait until any prior execution of this algorithm has terminated.
 2. Display a prompt to the user requesting that the user specify some files. If the [**multiple**](#) attribute is not set on *element*, there must be no more than one file selected; otherwise, any number may be selected. Files can be from the filesystem or created on the fly, e.g., a picture taken from a camera connected to the user's device.
 3. Wait for the user to have made their selection.
 4. If the user dismissed the prompt without changing their selection, then [queue an element task](#) on the [user interaction task source](#) given *element* to [fire an event](#) named [**cancel**](#) at *element*, with the [**bubbles**](#) attribute initialized to true.
 5. Otherwise, [update the file selection](#) for *element*.

As with all user interface specifications, user agents have a good deal of freedom in how they interpret these requirements. The above text implies that a user either dismisses the prompt or changes their selection; exactly one of these will be true. But the mapping of these possibilities to specific user interface elements is not mandated by the standard. For example, a user agent might interpret clicking the "Cancel" button when files were previously selected as a change of selection to select zero files, thus firing [input](#) and [change](#). Or it might interpret such a click as a dismissal that leaves the selection unchanged, thus firing [**cancel**](#). Similarly, it's up to the user agent whether re-selecting the same files counts as were previously selected counts as a dismissal, or as a change of selection.

If the element is [**mutable**](#), the user agent should allow the user to change the files on the list in other ways also, e.g., adding or removing files by drag-and-drop. When the user does so, the user agent must [update the file selection](#) for the element.

If the element is not [**mutable**](#), the user agent must not allow the user to change the element's selection.

To update the file selection for an element *element*:

1. Queue an element task on the user interaction task source given *element* and the following steps:
 1. Update *element*'s selected files so that it represents the user's selection.
 2. Fire an event named `input` at the `input` element, with the `bubbles` and `composed` attributes initialized to true.
 3. Fire an event named `change` at the `input` element, with the `bubbles` attribute initialized to true.

Constraint validation: If the element is `required` and the list of selected files is empty, then the element is suffering from being missing.



[Element/input#attr-accept](#)

Support in all current engines.

Firefox 37+ Safari 11.1+ Chrome 26+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 37+ Safari iOS 11.3+ Chrome Android 26+ WebView Android 4.4+ Samsung Internet 1.5+ Opera Android 15+

The `accept` attribute may be specified to provide user agents with a hint of what file types will be accepted.

If specified, the attribute must consist of a set of comma-separated tokens, each of which must be an ASCII case-insensitive match for one of the following:

The string "**audio/***"

Indicates that sound files are accepted.

The string "**video/***"

Indicates that video files are accepted.

The string "**image/***"

Indicates that image files are accepted.

A [valid MIME type string with no parameters](#)

Indicates that files of the specified type are accepted.

A string whose first character is a U+002E FULL STOP character (.)

Indicates that files with the specified file extension are accepted.

The tokens must not be [ASCII case-insensitive](#) matches for any of the other tokens (i.e. duplicates are not allowed). To obtain the list of tokens from the attribute, the user agent must [split the attribute value on commas](#).

User agents may use the value of this attribute to display a more appropriate user interface than a generic file picker. For instance, given the value `image/*`, a user agent could offer the user the option of using a local camera or selecting a photograph from their photo collection; given the value `audio/*`, a user agent could offer the user the option of recording a clip using a headset microphone.

User agents should prevent the user from selecting files that are not accepted by one (or more) of these tokens.

Authors are encouraged to specify both any MIME types and any corresponding extensions when looking for data in a specific format.

For example, consider an application that converts Microsoft Word documents to Open Document Format files. Since Microsoft Word documents are described with a wide variety of MIME types and extensions, the site can list several, as follows:

```
<input type="file" accept=".doc,.docx,.xml,application/msword,application/vnd
```

On platforms that only use file extensions to describe file types, the extensions listed here can be used to filter the allowed documents, while the MIME types can be used with the system's type registration table (mapping MIME types to extensions used by the system), if any, to determine any other extensions to allow. Similarly, on a system that does not have filenames or extensions but labels documents with MIME types internally, the MIME types can be used to pick the allowed files, while the extensions can be used if the system has an extension registration table that maps known extensions to MIME types used by the system.

Extensions tend to be ambiguous (e.g. there are an untold number of formats that use the `.dat` extension, and users can typically quite easily rename their files to have a `.doc` extension even if they are not Microsoft Word documents), and MIME types tend to be unreliable (e.g. many formats have no formally registered types, and many formats are in practice labeled using a number of different MIME types). Authors are reminded that, as usual, data received from a client should be treated with caution, as it may not be in an expected format even if the user is not hostile and the user agent fully obeyed the [accept](#) attribute's requirements.

MDN

[Element/input/file](#)

For historical reasons, the [value](#) IDL attribute prefixes the filename with the string

"C:\\fakepath\\". Some legacy user agents actually included the full path (which was a security vulnerability). As a result of this, obtaining the filename from the [value](#) IDL attribute in a backwards-compatible way is non-trivial. The following function extracts the filename in a suitably compatible manner:

```
function extractFilename(path) {
  if (path.substr(0, 12) == "C:\\fakepath\\")
    return path.substr(12); // modern browser
  var x;
  x = path.lastIndexOf('/');
  if (x >= 0) // Unix-based path
    return path.substr(x+1);
  x = path.lastIndexOf('\\');
  if (x >= 0) // Windows-based path
    return path.substr(x+1);
  return path; // just the filename
}
```

This can be used as follows:

```
<p><input type=file name=image onchange="updateFilename(this.value)"></p>
<p>The name of the file you picked is: <span id="filename">(none)</span></p>
<script>
  function updateFilename(path) {
    var name = extractFilename(path);
    document.getElementById('filename').textContent = name;
  }
</script>
```

The following common [input](#) element content attributes and IDL attributes [apply](#) to the element: [accept](#), [multiple](#), and [required](#) content attributes; [files](#) and [value](#) IDL attributes; [select\(\)](#) method.

The [value](#) IDL attribute is in mode [filename](#).

The [input](#) and [change](#) events [apply](#).

The following content attributes must not be specified and [do not apply](#) to the element: [alt](#), [autocomplete](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [pattern](#), [placeholder](#), [readonly](#), [size](#), [src](#), [step](#), and [width](#).

The element's [value](#) attribute must be omitted.

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and

[valueAsNumber](#) IDL attributes; [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

4.10.5.1.18 Submit Button state (**type=submit**)



[Element/input/submit](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Submit Button](#) state, the rules in this section apply.

(This

is a

tracking

vector.) The [input](#) element [represents](#) a button that, when activated, submits the form. If the element has a [value](#) attribute, the button's label must be the value of that attribute; otherwise, it must be an [implementation-defined](#) string that means "Submit" or some such. The element is a [button](#), specifically a [submit button](#).

Since the default label is [implementation-defined](#), and the width of the button typically depends on the button's label, the button's width can leak a few bits of fingerprintable information. These bits are likely to be strongly correlated to the identity of the user agent and the user's locale.

The element's [input activation behavior](#) is as follows:

1. If the element does not have a [form owner](#), then return.
2. If the element's [node document](#) is not [fully active](#), then return.
3. [Submit](#) the [form owner](#) from the element.

The [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), and [formtarget](#) attributes are [attributes for form submission](#).

The [formnovalidate](#) attribute can be used to make submit buttons that do not trigger the constraint validation.

The following common [input](#) element content attributes and IDL attributes [apply](#) to the element: [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), and [formtarget](#) content attributes; [value](#) IDL attribute.

The [value](#) IDL attribute is in mode [default](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [autocomplete](#), [checked](#), [dirname](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [input](#) and [change](#) events [do not apply](#).

4.10.5.1.19 Image Button state (`type=image`)



[Element/input/image](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android? WebView Android Yes Samsung Internet? Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Image Button](#) state, the rules in this section apply.

The [input](#) element [represents](#) either an image from which a user can select a coordinate and submit the form, or alternatively a button from which the user can submit the form. The element is a [button](#), specifically a [submit button](#).

The coordinate is sent to the server [during form submission](#) by sending two entries for the element, derived from the name of the control but with ".x" and ".y" appended to the name with the x and y components of the coordinate respectively.

The image is given by the [src](#) attribute. The [src](#) attribute must be present, and must contain

a [valid non-empty URL potentially surrounded by spaces](#) referencing a non-interactive, optionally animated, image resource that is neither paged nor scripted.

When any of the these events occur

- the [input](#) element's [type](#) attribute is first set to the [Image Button](#) state (possibly when the element is first created), and the [src](#) attribute is present
- the [input](#) element's [type](#) attribute is changed back to the [Image Button](#) state, and the [src](#) attribute is present, and its value has changed since the last time the [type](#) attribute was in the [Image Button](#) state
- the [input](#) element's [type](#) attribute is in the [Image Button](#) state, and the [src](#) attribute is set or changed

then unless the user agent cannot support images, or its support for images has been disabled, or the user agent only fetches images on demand, or the [src](#) attribute's value is the empty string, the user agent must [parse](#) the value of the [src](#) attribute value, relative to the element's [node document](#), and if that is successful, then:

1. Let [request](#) be a new [request](#) whose [URL](#) is the [resulting URL record](#), [client](#) is the element's [node document](#)'s [relevant settings object](#), [destination](#) is "[image](#)", [credentials mode](#) is "[include](#)", and whose [use-URL-credentials flag](#) is set.
2. [Fetch request](#).

Fetching the image must [delay the load event](#) of the element's [node document](#) until the [task](#) that is [queued](#) by the [networking task source](#) once the resource has been fetched (defined below) has been run.

If the image was successfully obtained, with no network errors, and the image's type is a supported image type, and the image is a valid image of that type, then the image is said to be *available*. If this is true before the image is completely downloaded, each [task](#) that is [queued](#) by the [networking task source](#) while the image is being fetched must update the presentation of the image appropriately.

The user agent should apply the [image sniffing rules](#) to determine the type of the image, with the image's [associated Content-Type headers](#) giving the *official type*. If these rules are not applied, then the type of the image must be the type given by the image's [associated Content-Type headers](#).

User agents must not support non-image resources with the [input](#) element. User agents must not run executable code embedded in the image resource. User agents must only display the first page of a multipage resource. User agents must not allow the resource to act in an interactive fashion, but should honor any animation in the resource.

The [task](#) that is [queued](#) by the [networking task source](#) once the resource has been fetched, must, if the download was successful and the image is *available*, [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to [fire an event](#) named [load](#) at the

[input](#) element; and otherwise, if the fetching process fails without a response from the remote server, or completes but the image is not a valid or supported image, [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to [fire an event](#) named [error](#) on the [input](#) element.

The [alt](#) attribute provides the textual label for the button for users and user agents who cannot use the image. The [alt](#) attribute must be present, and must contain a non-empty string giving the label that would be appropriate for an equivalent button if the image was unavailable.

The [input](#) element supports [dimension attributes](#).

If the [src](#) attribute is set, and the image is [available](#) and the user agent is configured to display that image, then the element [represents](#) a control for selecting a [coordinate](#) from the image specified by the [src](#) attribute. In that case, if the element is [mutable](#), the user agent should allow the user to select this [coordinate](#).

Otherwise, the element [represents](#) a submit button whose label is given by the value of the [alt](#) attribute.

The element's [input activation behavior](#) is as follows:

1. If the element does not have a [form owner](#), then return.
2. If the element's [node document](#) is not [fully active](#), then return.
3. Let *coordinate* be (0, 0).
4. If the user activated the control while explicitly selecting a coordinate, then set *coordinate* to that coordinate.

This is only possible under the conditions outlined above, when the element [represents](#) a control for selecting such a coordinate. Even then, the user might activate the control without explicitly selecting a coordinate.

5. Set the element's [selected coordinate](#) to *coordinate*.
6. [Submit](#) the [form owner](#) from the element.

The *selected coordinate* must consist of an *x*-component and a *y*-component. The coordinates represent the position relative to the edge of the image, with the coordinate space having the positive *x* direction to the right, and the positive *y* direction downwards.

The *x*-component must be a [valid integer](#) representing a number *x* in the range $-(borderleft+paddingleft) \leq x \leq width+borderright+paddingright$, where *width* is the rendered

width of the image, *borderleft* is the width of the border on the left of the image, *paddingleft* is the width of the padding on the left of the image, *borderright* is the width of the border on the right of the image, and *paddingright* is the width of the padding on the right of the image, with all dimensions given in [CSS pixels](#).

The y-component must be a [valid integer](#) representing a number *y* in the range $-(\text{border}_{\text{top}} + \text{padding}_{\text{top}}) \leq y \leq \text{height} + \text{border}_{\text{bottom}} + \text{padding}_{\text{bottom}}$, where *height* is the rendered height of the image, *border_{top}* is the width of the border above the image, *padding_{top}* is the width of the padding above the image, *border_{bottom}* is the width of the border below the image, and *padding_{bottom}* is the width of the padding below the image, with all dimensions given in [CSS pixels](#).

Where a border or padding is missing, its width is zero [CSS pixels](#).

The [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), and [formtarget](#) attributes are [attributes for form submission](#).

`image.width [= value]`
`image.height [= value]`

These attributes return the actual rendered dimensions of the image, or zero if the dimensions are not known.

They can be set, to change the corresponding content attributes.

The following common [input](#) element content attributes and IDL attributes [apply](#) to the element: [alt](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [src](#), and [width](#) content attributes; [value](#) IDL attribute.

The [value](#) IDL attribute is in mode [default](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [autocomplete](#), [checked](#), [dirname](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), and [step](#).

The element's [value](#) attribute must be omitted.

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [input](#) and [change](#) events [do not apply](#).

Many aspects of this state's behavior are similar to the behavior of the [img](#) element. Readers

are encouraged to read that section, where many of the same requirements are described in more detail.

Take the following form:

```
<form action="process.cgi">  
  <input type=image src=map.png name=where alt="Show location list">  
</form>
```

If the user clicked on the image at coordinate (127,40) then the URL used to submit the form would be "process.cgi?where.x=127&where.y=40".

(In this example, it's assumed that for users who don't see the map, and who instead just see a button labeled "Show location list", clicking the button will cause the server to show a list of locations to pick from instead of the map.)

4.10.5.1.20 Reset Button state (**type=reset**)



[Element/input/reset](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Reset Button](#) state, the rules in this section apply.

(This

is a

tracking

[vector.](#)) The [input](#) element [represents](#) a button that, when activated, resets the form. If the element has a [value](#) attribute, the button's label must be the value of that attribute; otherwise, it must be an [implementation-defined](#) string that means "Reset" or some such. The element is a [button](#).

Since the default label is [implementation-defined](#), and the width of the button typically depends on the button's label, the button's width can leak a few bits of fingerprintable information. These bits are likely to be strongly correlated to the identity of the user agent and the user's locale.

The element's [input activation behavior](#) is as follows:

1. If the element does not have a [form owner](#), then return.
2. If the element's [node document](#) is not [fully active](#), then return.
3. [Reset](#) the [form owner](#) from the element.

Constraint validation: The element is [barred from constraint validation](#).

The [value](#) IDL attribute [applies](#) to this element and is in mode [default](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [autocomplete](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [input](#) and [change](#) events [do not apply](#).

4.10.5.1.21 Button state (`type=button`)



[Element/input/button](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android 18+ WebView Android Yes Samsung Internet 1.0+ Opera Android Yes

When an [input](#) element's [type](#) attribute is in the [Button](#) state, the rules in this section apply.

The [input](#) element [represents](#) a button with no default behavior. A label for the button must be provided in the [value](#) attribute, though it may be the empty string. If the element has a [value](#) attribute, the button's label must be the value of that attribute; otherwise, it must be the empty string. The element is a [button](#).

The element has no [input activation behavior](#).

Constraint validation: The element is [barred from constraint validation](#).

The [**value**](#) IDL attribute [applies](#) to this element and is in mode [default](#).

The following content attributes must not be specified and [do not apply](#) to the element: [accept](#), [alt](#), [autocomplete](#), [checked](#), [dirname](#), [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), [formtarget](#), [height](#), [list](#), [max](#), [maxlength](#), [min](#), [minlength](#), [multiple](#), [pattern](#), [placeholder](#), [readonly](#), [required](#), [size](#), [src](#), [step](#), and [width](#).

The following IDL attributes and methods [do not apply](#) to the element: [checked](#), [files](#), [list](#), [selectionStart](#), [selectionEnd](#), [selectionDirection](#), [valueAsDate](#), and [valueAsNumber](#) IDL attributes; [select\(\)](#), [setRangeText\(\)](#), [setSelectionRange\(\)](#), [stepDown\(\)](#), and [stepUp\(\)](#) methods.

The [**input**](#) and [**change**](#) events [do not apply](#).

4.10.5.2 Implementation notes regarding localization of form controls

This section is non-normative.

The formats shown to the user in date, time, and number controls is independent of the format used for form submission.

Browsers are encouraged to use user interfaces that present dates, times, and numbers according to the conventions of either the locale implied by the [**input**](#) element's [language](#) or the user's preferred locale. Using the page's locale will ensure consistency with page-provided data.

For example, it would be confusing to users if an American English page claimed that a Cirque De Soleil show was going to be showing on 02/03, but their browser, configured to use the British English locale, only showed the date 03/02 in the ticket purchase date picker. Using the page's locale would at least ensure that the date was presented in the same format everywhere. (There's still a risk that the user would end up arriving a month late, of course, but there's only so much that can be done about such cultural differences...)

4.10.5.3 Common [**input**](#) element attributes

These attributes only [apply](#) to an [**input**](#) element if its [type](#) attribute is in a state whose definition declares that the attribute [applies](#). When an attribute [doesn't apply](#) to an [**input**](#) element, user agents must [ignore](#) the attribute, regardless of the requirements and definitions below.

4.10.5.3.1 The [maxlength](#) and [minlength](#) attributes

[Element/input#attr-maxlength](#)

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 4+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 5+ Safari iOS 9+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.5+ Opera Android 15+

[caniuse.com table](#)

The **maxlength** attribute, when it [applies](#), is a [form control maxlength attribute](#).



[Element/input#attr-minlength](#)

Support in all current engines.

Firefox 51+ Safari 10.1+ Chrome 40+

Opera 27+ Edge 79+

Edge (Legacy) 17+ Internet Explorer No

Firefox Android 51+ Safari iOS 10.3+ Chrome Android 40+ WebView Android 40+ Samsung Internet 4.0+ Opera Android 27+

[caniuse.com table](#)

The **minlength** attribute, when it [applies](#), is a [form control minlength attribute](#).

If the **input** element has a [maximum allowed value length](#), then the [length](#) of the value of the element's [value](#) attribute must be equal to or less than the element's [maximum allowed value length](#).

The following extract shows how a messaging client's text entry could be arbitrarily restricted to a fixed number of characters, thus forcing any conversation through this medium to be terse and discouraging intelligent discourse.

```
<label>What are you doing? <input name=status maxlength=140></label>
```

Here, a password is given a minimum length:

```
<p><label>Username: <input name=u required></label>
<p><label>Password: <input name=p required minlength=12></label>
```

4.10.5.3.2 The `size` attribute

The `size` attribute gives the number of characters that, in a visual rendering, the user agent is to allow the user to see while editing the element's [value](#).

The `size` attribute, if specified, must have a value that is a [valid non-negative integer](#) greater than zero.

If the attribute is present, then its value must be parsed using the [rules for parsing non-negative integers](#), and if the result is a number greater than zero, then the user agent should ensure that at least that many characters are visible.

The `size` IDL attribute is [limited to only non-negative numbers greater than zero](#) and has a default value of 20.

4.10.5.3.3 The `readonly` attribute



[Attributes/readonly](#)

Support in all current engines.

Firefox 1+ Safari ≤ 4+ Chrome 1+

Opera ≤ 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer ≤ 6+

Firefox Android 4+ Safari iOS ≤ 3+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android ≤ 12.1+

The `readonly` attribute is a [boolean attribute](#) that controls whether or not the user can edit the form control. When specified, the element is not [mutable](#).

Constraint validation: If the `readonly` attribute is specified on an `input` element, the element is [barred from constraint validation](#).

The difference between `disabled` and `readonly` is that read-only controls can still function, whereas disabled controls generally do not function as controls until they are enabled. This is spelled out in more detail elsewhere in this specification with normative requirements that refer to the `disabled` concept (for example, the element's [activation behavior](#), whether or not it is a [focusable area](#), or when [constructing the entry list](#)). Any other behavior related to user interaction with disabled controls, such as whether text can be selected or copied, is not defined in this standard.

Only text controls can be made read-only, since for other controls (such as checkboxes and buttons) there is no useful distinction between being read-only and being disabled, so the `readonly` attribute [does not apply](#).

In the following example, the existing product identifiers cannot be modified, but they are still displayed as part of the form, for consistency with the row representing a new product (where the identifier is not yet filled in).

```
<form action="products.cgi" method="post" enctype="multipart/form-data">
<table>
  <tr> <th> Product ID <th> Product name <th> Price <th> Action
  <tr>
    <td> <input readonly="readonly" name="1.pid" value="H412">
    <td> <input required="required" name="1.pname" value="Floor lamp Ulke">
    <td> $<input required="required" type="number" min="0" step="0.01" name="1.pprice">
    <td> <button formnovalidate="formnovalidate" name="action" value="delete:1">
  <tr>
    <td> <input readonly="readonly" name="2.pid" value="FG28">
    <td> <input required="required" name="2.pname" value="Table lamp Ulke">
    <td> $<input required="required" type="number" min="0" step="0.01" name="2.pprice">
    <td> <button formnovalidate="formnovalidate" name="action" value="delete:2">
  <tr>
    <td> <input required="required" name="3.pid" value="" pattern="[A-Z0-9]+>
    <td> <input required="required" name="3.pname" value="">
    <td> $<input required="required" type="number" min="0" step="0.01" name="3.pprice">
    <td> <button formnovalidate="formnovalidate" name="action" value="delete:3">
</table>
<p> <button formnovalidate="formnovalidate" name="action" value="add">Add</button>
<p> <button name="action" value="update">Save</button> </p>
</form>
```

4.10.5.3.4 The [required](#) attribute

The **required** attribute is a [boolean attribute](#). When specified, the element is *required*.

Constraint validation: If the element is [required](#), and its [value](#) IDL attribute [applies](#) and is in the mode [value](#), and the element is [mutable](#), and the element's [value](#) is the empty string, then the element is [suffering from being missing](#).

The following form has two required fields, one for an email address and one for a password. It also has a third field that is only considered valid if the user types the same password in the password field and this third field.

```
<h1>Create new account</h1>
<form action="/newaccount" method=post
      oninput="up2.setCustomValidity(up2.value != up.value ? 'Passwords do not match' : '')">
  <p>
    <label for="username">Email address:</label>
    <input id="username" type=email required name=username>
  <p>
    <label for="password1">Password:</label>
    <input id="password1" type=password required name=password1>
    <input id="password2" type=password required name=password2>
  </p>
</form>
```

```

<input id="password1" type=password required name=up>
<p>
  <label for="password2">Confirm password:</label>
  <input id="password2" type=password name=up2>
<p>
  <input type=submit value="Create account">
</form>

```

For radio buttons, the [required](#) attribute is satisfied if any of the radio buttons in the [group](#) is selected. Thus, in the following example, any of the radio buttons can be checked, not just the one marked as required:

```

<fieldset>
  <legend>Did the movie pass the Bechdel test?</legend>
  <p><label><input type="radio" name="bechdel" value="no-characters"> No, there
  <p><label><input type="radio" name="bechdel" value="no-names"> No, the female
  <p><label><input type="radio" name="bechdel" value="no-topic"> No, when female
  <p><label><input type="radio" name="bechdel" value="yes" required> Yes. </label>
  <p><label><input type="radio" name="bechdel" value="unknown"> I don't know. </label>
</fieldset>

```

To avoid confusion as to whether a [radio button group](#) is required or not, authors are encouraged to specify the attribute on all the radio buttons in a group. Indeed, in general, authors are encouraged to avoid having radio button groups that do not have any initially checked controls in the first place, as this is a state that the user cannot return to, and is therefore generally considered a poor user interface.

4.10.5.3.5 The [multiple](#) attribute



[Element/input#attr-multiple](#)

Support in all current engines.

Firefox 3.6+ Safari 4+ Chrome 2+

Opera ≤ 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android ≤ 37+ Samsung Internet 1.0+ Opera Android ≤ 12.1+

The [multiple](#) attribute is a [boolean attribute](#) that indicates whether the user is to be allowed to specify more than one value.

The following extract shows how an email client's "To" field could accept multiple email addresses.

```
<label>To: <input type=email multiple name=to></label>
```

If the user had, amongst many friends in their user contacts database, two friends "Spider-Man" (with address "spider@example.net") and "Scarlet Witch" (with address "scarlet@avengers.example.net"), then, after the user has typed "**s**", the user agent might suggest these two email addresses to the user.

Send Save Now Discard

To: s ▼

spider@example.net	Spider-Man
scarlet@avengers.example.net	Scarlet Witch

The page could also link in the user's contacts database from the site:

```
<label>To: <input type=email multiple name=to list=contacts></label>
...
<datalist id="contacts">
  <option value="hedral@damowmow.com">
  <option value="pillar@example.com">
  <option value="astrophysics@cute.example">
  <option value="astronomy@science.example.org">
</datalist>
```

Suppose the user had entered "**bob@example.net**" into this text control, and then started typing a second email address starting with "**s**". The user agent might show both the two friends mentioned earlier, as well as the "astrophysics" and "astronomy" values given in the [datalist](#) element.

Send Save Now Discard

To: bob@example.net, s ▼

spider@example.net	Spider-Man
scarlet@avengers.example.net	Scarlet Witch
astronomy@science.example.org	
astrophysics@cute.example	

The following extract shows how an email client's "Attachments" field could accept multiple files for upload.

```
<label>Attachments: <input type=file multiple name=att></label>
```

4.10.5.3.6 The [pattern](#) attribute

[Attributes/pattern](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 4+

Opera ≤ 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 4+ Chrome Android 18+ WebView Android ≤ 37+ Samsung Internet 1.0+ Opera Android ≤ 12.1+

The **pattern** attribute specifies a regular expression against which the control's [value](#), or, when the [multiple](#) attribute [applies](#) and is set, the control's [values](#), are to be checked.

If specified, the attribute's value must match the JavaScript [Pattern](#)[+U, +N] production.

The *compiled pattern regular expression* of an [input](#) element, if it exists, is a JavaScript [RegExp](#) object. It is determined as follows:

1. If the element does not have a [pattern](#) attribute specified, then return nothing. The element has no [compiled pattern regular expression](#).
2. Let *pattern* be the value of the [pattern](#) attribute of the element.
3. Let *regexpCompletion* be [RegExpCreate](#)(*pattern*, "u"). [\[JAVASCRIPT\]](#)
4. If *regexpCompletion* is an [abrupt completion](#), then return nothing. The element has no [compiled pattern regular expression](#).

User agents are encouraged to log this error in a developer console, to aid debugging.

5. Let *anchoredPattern* be the string "^(:?", followed by *pattern*, followed by ")\$".
6. Return ! [RegExpCreate](#)(*anchoredPattern*, "u").

The reasoning behind these steps, instead of just using the value of the [pattern](#) attribute directly, is twofold. First, we want to ensure that when matched against a string, the regular expression's start is anchored to the start of the string and its end to the end of the string. Second, we want to ensure that the regular expression is valid in standalone form, instead of only becoming valid after being surrounded by the "^(:?" and ")\$" anchors.

A [RegExp](#) object *regexp* matches a string *input*, if ! [RegExpBuiltinExec](#)(*regexp*, *input*) is not null.

Constraint validation: If the element's [value](#) is not the empty string, and either the element's [multiple](#) attribute is not specified or it [does not apply](#) to the [input](#) element given its [type](#) attribute's current state, and the element has a [compiled pattern regular expression](#) but that regular expression does not [match](#) the element's [value](#), then the element is [suffering from a](#)

[pattern mismatch](#)

Constraint validation: If the element's [value](#) is not the empty string, and the element's [multiple](#) attribute is specified and [applies](#) to the [input](#) element, and the element has a [compiled pattern regular expression](#) but that regular expression does not [match](#) each of the element's [values](#), then the element is [suffering from a pattern mismatch](#).

When an [input](#) element has a [pattern](#) attribute specified, authors should include a [title](#) attribute to give a description of the pattern. User agents may use the contents of this attribute, if it is present, when informing the user that the pattern is not matched, or at any other suitable time, such as in a tooltip or read out by assistive technology when the control [gains focus](#).

For example, the following snippet:

```
<label> Part number:  
  <input pattern="[0-9][A-Z]{3}" name="part"  
        title="A part number is a digit followed by three uppercase letters.">  
</label>
```

...could cause the UA to display an alert such as:

A part number is a digit followed by three uppercase letters.
You cannot submit this form when the field is incorrect.

When a control has a [pattern](#) attribute, the [title](#) attribute, if used, must describe the pattern. Additional information could also be included, so long as it assists the user in filling in the control. Otherwise, assistive technology would be impaired.

For instance, if the title attribute contained the caption of the control, assistive technology could end up saying something like **The text you have entered does not match the required pattern. Birthday**, which is not useful.

UAs may still show the [title](#) in non-error situations (for example, as a tooltip when hovering over the control), so authors should be careful not to word [titles](#) as if an error has necessarily occurred.

4.10.5.3.7 The [min](#) and [max](#) attributes

Some form controls can have explicit constraints applied limiting the allowed range of values that the user can provide. Normally, such a range would be linear and continuous. A form control can *have a periodic domain*, however, in which case the form control's broadest possible range is finite, and authors can specify explicit ranges within it that span the boundaries.

Specifically, the broadest range of a [type=time](#) control is midnight to midnight (24 hours), and authors can set both continuous linear ranges (such as 9pm to 11pm) and discontinuous ranges spanning midnight (such as 11pm to 1am).

The `min` and `max` attributes indicate the allowed range of values for the element.

Their syntax is defined by the section that defines the `type` attribute's current state.

If the element has a `min` attribute, and the result of applying the [algorithm to convert a string to a number](#) to the value of the `min` attribute is a number, then that number is the element's *minimum*; otherwise, if the `type` attribute's current state defines a *default minimum*, then that is the minimum; otherwise, the element has no minimum.

The `min` attribute also defines the [step base](#).

If the element has a `max` attribute, and the result of applying the [algorithm to convert a string to a number](#) to the value of the `max` attribute is a number, then that number is the element's *maximum*; otherwise, if the `type` attribute's current state defines a *default maximum*, then that is the maximum; otherwise, the element has no maximum.

If the element does not [have a periodic domain](#), the `max` attribute's value (the maximum) must not be less than the `min` attribute's value (its minimum).

If an element that does not [have a periodic domain](#) has a maximum that is less than its minimum, then so long as the element has a [value](#), it will either be [suffering from an underflow](#) or [suffering from an overflow](#).

An element *has a reversed range* if it [has a periodic domain](#) and its maximum is less than its minimum.

An element *has range limitations* if it has a defined minimum or a defined maximum.

Constraint validation: When the element has a minimum and does not [have a reversed range](#), and the result of applying the [algorithm to convert a string to a number](#) to the string given by the element's [value](#) is a number, and the number obtained from that algorithm is less than the minimum, the element is [suffering from an underflow](#).

Constraint validation: When the element has a maximum and does not [have a reversed range](#), and the result of applying the [algorithm to convert a string to a number](#) to the string given by the element's [value](#) is a number, and the number obtained from that algorithm is more than the maximum, the element is [suffering from an overflow](#).

Constraint validation: When an element [has a reversed range](#), and the result of applying the [algorithm to convert a string to a number](#) to the string given by the element's [value](#) is a number, and the number obtained from that algorithm is more than the maximum and less than the minimum, the element is simultaneously [suffering from an underflow](#) and [suffering from an overflow](#).

The following date control limits input to dates that are before the 1980s:

```
<input name=bdy type=date max="1979-12-31">
```

The following number control limits input to whole numbers greater than zero:

```
<input name=quantity required="" type="number" min="1" value="1">
```

The following time control limits input to those minutes that occur between 9pm and 6am, defaulting to midnight:

```
<input name="sleepStart" type=time min="21:00" max="06:00" step="60" value="0
```

4.10.5.3.8 The **step** attribute

The **step** attribute indicates the granularity that is expected (and required) of the [value](#) or [values](#), by limiting the allowed values. The section that defines the [type](#) attribute's current state also defines the *default step*, the *step scale factor*, and in some cases the *default step base*, which are used in processing the attribute as described below.

The **step** attribute, if specified, must either have a value that is a [valid floating-point number](#) that [parses](#) to a number that is greater than zero, or must have a value that is an [ASCII case-insensitive](#) match for the string "any".

The attribute provides the *allowed value step* for the element, as follows:

1. If the attribute does not [apply](#), then there is no [allowed value step](#).
2. Otherwise, if the attribute is absent, then the [allowed value step](#) is the [default step](#) multiplied by the [step scale factor](#).
3. Otherwise, if the attribute's value is an [ASCII case-insensitive](#) match for the string "any", then there is no [allowed value step](#).
4. Otherwise, if the [rules for parsing floating-point number values](#), when they are applied to the attribute's value, return an error, zero, or a number less than zero, then the [allowed value step](#) is the [default step](#) multiplied by the [step scale factor](#).
5. Otherwise, the [allowed value step](#) is the number returned by the [rules for parsing floating-point number values](#) when they are applied to the attribute's value, multiplied by the [step scale factor](#).

The *step base* is the value returned by the following algorithm:

1. If the element has a [min](#) content attribute, and the result of applying the [algorithm to convert a string to a number](#) to the value of the [min](#) content attribute is not an error, then return that result.
2. If the element has a [value](#) content attribute, and the result of applying the [algorithm to convert a string to a number](#) to the value of the [value](#) content attribute is not an error, then return that result.

3. If a [default step base](#) is defined for this element given its [type](#) attribute's state, then return it.
4. Return zero.

Constraint validation: When the element has an [allowed value step](#), and the result of applying the [algorithm to convert a string to a number](#) to the string given by the element's [value](#) is a number, and that number subtracted from the [step base](#) is not an integral multiple of the [allowed value step](#), the element is [suffering from a step mismatch](#).

The following range control only accepts values in the range 0..1, and allows 256 steps in that range:

```
<input name=opacity type=range min=0 max=1 step=0.00392156863>
```

The following control allows any time in the day to be selected, with any accuracy (e.g. thousandth-of-a-second accuracy or more):

```
<input name=favtime type=time step=any>
```

Normally, time controls are limited to an accuracy of one minute.

4.10.5.3.9 The [list](#) attribute

The [list](#) attribute is used to identify an element that lists predefined options suggested to the user.

If present, its value must be the [ID](#) of a [datalist](#) element in the same [tree](#).

The [suggestions source element](#) is the first element in the [tree](#) in [tree order](#) to have an [ID](#) equal to the value of the [list](#) attribute, if that element is a [datalist](#) element. If there is no [list](#) attribute, or if there is no element with that [ID](#), or if the first element with that [ID](#) is not a [datalist](#) element, then there is no [suggestions source element](#).

If there is a [suggestions source element](#), then, when the user agent is allowing the user to edit the [input](#) element's [value](#), the user agent should offer the suggestions represented by the [suggestions source element](#) to the user in a manner suitable for the type of control used. If appropriate, the user agent should use the suggestion's [label](#) and [value](#) to identify the suggestion to the user.

User agents are encouraged to filter the suggestions represented by the [suggestions source element](#) when the number of suggestions is large, including only the most relevant ones (e.g. based on the user's input so far). No precise threshold is defined, but capping the list at four to seven values is reasonable. If filtering based on the user's input, user agents should search within both the [label](#) and [value](#) of the suggestions for matches. User agents should consider how input variations affect the matching process. Unicode normalization should be applied so that different underlying Unicode code point sequences, caused by different keyboard- or input-

specific mechanisms, do not interfere with the matching process. Case variations should be ignored, which may require language-specific case mapping. For examples of these, see *Character Model for the World Wide Web: String Matching*. User agents may also provide other matching features: for illustration, a few examples include matching different forms of kana to each other (or to kanji), ignoring accents, or applying spelling correction. [CHARMODNORM]

This text field allows you to choose a type of JavaScript function.

```
<input type="text" list="function-types">
<datalist id="function-types">
  <option value="function">function</option>
  <option value="async function">async function</option>
  <option value="function*">generator function</option>
  <option value="=>">arrow function</option>
  <option value="async =>">async arrow function</option>
  <option value="async function*">async generator function</option>
</datalist>
```

For user agents that follow the above suggestions, both the [label](#) and [value](#) would be shown:



Then, typing "arrow" or "=>" would filter the list to the entries with labels "arrow function" and "async arrow function". Typing "generator" or "*" would filter the list to the entries with labels "generator function" and "async generator function".

As always, user agents are free to make user interface decisions which are appropriate for their particular requirements and for the user's particular circumstances. However, this has historically been an area of confusion for implementers, web developers, and users alike, so we've given some "should" suggestions above.

How user selections of suggestions are handled depends on whether the element is a control accepting a single value only, or whether it accepts multiple values:

If the element does not have a [multiple](#) attribute specified or if the [multiple](#) attribute [does not apply](#)

When the user selects a suggestion, the [input](#) element's [value](#) must be set to the selected suggestion's [value](#), as if the user had written that value themselves.

If the element's **type** attribute is in the [Email](#) state and the element has a **multiple** attribute specified

When the user selects a suggestion, the user agent must either add a new entry to the [input](#) element's [values](#), whose value is the selected suggestion's [value](#), or change an existing entry in the [input](#) element's [values](#) to have the value given by the selected suggestion's [value](#), as if the user had themselves added an entry with that value, or edited an existing entry to be that value. Which behavior is to be applied depends on the user interface in an [implementation-defined](#) manner.

If the [list](#) attribute [does not apply](#), there is no [suggestions source element](#).

This URL field offers some suggestions.

```
<label>Homepage: <input name=hp type=url list=hpurls></label>
<datalist id=hpurls>
  <option value="https://www.google.com/" label="Google">
  <option value="https://www.reddit.com/" label="Reddit">
</datalist>
```

Other URLs from the user's history might show also; this is up to the user agent.

This example demonstrates how to design a form that uses the autocompletion list feature while still degrading usefully in legacy user agents.

If the autocompletion list is merely an aid, and is not important to the content, then simply using a [datalist](#) element with children [option](#) elements is enough. To prevent the values from being rendered in legacy user agents, they need to be placed inside the [value](#) attribute instead of inline.

```
<p>
  <label>
    Enter a breed:
    <input type="text" name="breed" list="breeds">
    <datalist id="breeds">
      <option value="Abyssinian">
      <option value="Alpaca">
      <!-- ... -->
    </datalist>
  </label>
</p>
```

However, if the values need to be shown in legacy UAs, then fallback content can be placed inside the [datalist](#) element, as follows:

```
<p>
```

```

<label>
  Enter a breed:
  <input type="text" name="breed" list="breeds">
</label>
<datalist id="breeds">
  <label>
    or select one from the list:
    <select name="breed">
      <option value=""> (none selected)
      <option>Abyssinian
      <option>Alpaca
      <!-- ... -->
    </select>
  </label>
</datalist>
</p>

```

The fallback content will only be shown in UAs that don't support [datalist](#). The options, on the other hand, will be detected by all UAs, even though they are not children of the [datalist](#) element.

Note that if an [option](#) element used in a [datalist](#) is [selected](#), it will be selected by default by legacy UAs (because it affects the [select](#) element), but it will not have any effect on the [input](#) element in UAs that support [datalist](#).

4.10.5.3.10 The [placeholder](#) attribute



[Element/input#attr-placeholder](#)

Support in all current engines.

Firefox 4+ Safari 4+ Chrome 3+

Opera ≤ 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android ≤ 37+ Samsung Internet 1.0+ Opera Android ≤ 12.1+

The [placeholder](#) attribute represents a *short* hint (a word or short phrase) intended to aid the user with data entry when the control has no value. A hint could be a sample value or a brief description of the expected format. The attribute, if specified, must have a value that contains no U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR) characters.

The [placeholder](#) attribute should not be used as an alternative to a [label](#). For a longer hint or other advisory text, the [title](#) attribute is more appropriate.

These mechanisms are very similar but subtly different: the hint given by the control's [label](#) is shown at all times; the short hint given in the [placeholder](#) attribute is shown before the user enters a value; and the hint in the [title](#) attribute is shown when the user requests further help.

User agents should present this hint to the user, after having [stripped newlines](#) from it, when the element's [value](#) is the empty string, especially if the control is not [focused](#).

If a user agent normally doesn't show this hint to the user when the control is [focused](#), then the user agent should nonetheless show the hint for the control if it was focused as a result of the [autofocus](#) attribute, since in that case the user will not have had an opportunity to examine the control before focusing it.

Here is an example of a mail configuration user interface that uses the [placeholder](#) attribute:

```
<fieldset>
  <legend>Mail Account</legend>
  <p><label>Name: <input type="text" name="fullname" placeholder="John Ratzenb...</label></p>
  <p><label>Address: <input type="email" name="address" placeholder="john@example.com"></label></p>
  <p><label>Password: <input type="password" name="password"></label></p>
  <p><label>Description: <input type="text" name="desc" placeholder="My Email Address"></label></p>
</fieldset>
```

In situations where the control's content has one directionality but the placeholder needs to have a different directionality, Unicode's bidirectional-algorithm formatting characters can be used in the attribute value:

```
<input name=t1 type=tel placeholder="‫ رقم الهاتف 1"‮>
<input name=t2 type=tel placeholder="‫ رقم الهاتف 2"‮>
```

For slightly more clarity, here's the same example using numeric character references instead of inline Arabic:

```
<input name=t1 type=tel placeholder="‫&#1585;&#1602;&#1605; &#1575;&#1602;&#1605;">
<input name=t2 type=tel placeholder="‫&#1585;&#1602;&#1605; &#1575;&#1602;&#1605;">
```

4.10.5.4 Common [input](#) element APIs

[input.value](#) [= value]

Returns the current [value](#) of the form control.

Can be set, to change the value.

Throws an ["InvalidStateError" DOMException](#) if it is set to any value other than the empty string when the control is a file upload control.

`input.checked [= value]`

Returns the current [checkedness](#) of the form control.

Can be set, to change the [checkedness](#).

`input.files [= files]`

✓MDN

[FileList](#)

Support in all current engines.

Firefox 3+ Safari 4+ Chrome 1+

Opera 11.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11.1+

Returns a [FileList](#) object listing the [selected files](#) of the form control.

Returns null if the control isn't a file control.

Can be set to a [FileList](#) object to change the [selected files](#) of the form control. For instance, as the result of a drag-and-drop operation.

`input.valueAsDate [= value]`

Returns a [Date](#) object representing the form control's [value](#), if applicable; otherwise, returns null.

Can be set, to change the value.

Throws an ["InvalidStateError"](#) [DOMException](#) if the control isn't date- or time-based.

`input.valueAsNumber [= value]`

Returns a number representing the form control's [value](#), if applicable; otherwise, returns NaN.

Can be set, to change the value. Setting this to NaN will set the underlying value to the empty string.

Throws an ["InvalidStateError"](#) [DOMException](#) if the control is neither date- or time-based nor numeric.

`input.stepUp([n])`

MDN

[HTMLInputElement/stepUp](#)

Firefox 16+ Safari 5+ Chrome 5+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 16+ Safari iOS 4+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

`input.stepDown([n])`

MDN

[HTMLInputElement/stepDown](#)

Firefox 16+ Safari 5+ Chrome 5+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 16+ Safari iOS 4+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Changes the form control's [value](#) by the value given in the [step](#) attribute, multiplied by *n*. The default value for *n* is 1.

Throws "[InvalidStateError](#)" [DOMException](#) if the control is neither date- or time-based nor numeric, or if the [step](#) attribute's value is "any".

`input.list`

Returns the [datalist](#) element indicated by the [list](#) attribute.

The **value** IDL attribute allows scripts to manipulate the [value](#) of an [input](#) element. The attribute is in one of the following modes, which define its behavior:

`value`

On getting, return the current [value](#) of the element.

On setting:

1. Let *oldValue* be the element's [value](#).
2. Set the element's [value](#) to the new value.
3. Set the element's [dirty value flag](#) to true.

4. Invoke the [value sanitization algorithm](#), if the element's [type](#) attribute's current state defines one.
5. If the element's [value](#) (after applying the [value sanitization algorithm](#)) is different from *oldValue*, and the element has a [text entry cursor position](#), move the [text entry cursor position](#) to the end of the text control, unselecting any selected text and [resetting the selection direction](#) to "none".

default

On getting, if the element has a [value](#) content attribute, return that attribute's value; otherwise, return the empty string.

On setting, set the value of the element's [value](#) content attribute to the new value.

default/on

On getting, if the element has a [value](#) content attribute, return that attribute's value; otherwise, return the string "on".

On setting, set the value of the element's [value](#) content attribute to the new value.

filename

On getting, return the string "C:\fakepath\" followed by the name of the first file in the list of [selected files](#), if any, or the empty string if the list is empty.

On setting, if the new value is the empty string, empty the list of [selected files](#); otherwise, throw an ["InvalidStateError" DOMException](#).

This "fakepath" requirement is a sad accident of history. See [the example in the File Upload state section](#) for more information.

Since [path components](#) are not permitted in filenames in the list of [selected files](#), the "\fakepath\" cannot be mistaken for a path component.

The [checked](#) IDL attribute allows scripts to manipulate the [checkedness](#) of an [input](#) element. On getting, it must return the current [checkedness](#) of the element; and on setting, it must set the element's [checkedness](#) to the new value and set the element's [dirty checkedness flag](#) to true.

The [files](#) IDL attribute allows scripts to access the element's [selected files](#).

On getting, if the IDL attribute [applies](#), it must return a [FileList](#) object that represents the current [selected files](#). The same object must be returned until the list of [selected files](#) changes. If the IDL attribute [does not apply](#), then it must instead return null. [\[FILEAPI\]](#)

On setting, it must run these steps:

1. If the IDL attribute [does not apply](#) or the given value is null, then return.
 2. Replace the element's [selected files](#) with the given value.
-

The **valueAsDate** IDL attribute represents the [value](#) of the element, interpreted as a date.

On getting, if the [valueAsDate](#) attribute [does not apply](#), as defined for the [input](#) element's [type](#) attribute's current state, then return null. Otherwise, run the [algorithm to convert a string to a Date object](#) defined for that state to the element's [value](#); if the algorithm returned a [Date](#) object, then return it, otherwise, return null.

On setting, if the [valueAsDate](#) attribute [does not apply](#), as defined for the [input](#) element's [type](#) attribute's current state, then throw an ["InvalidStateError" DOMException](#); otherwise, if the new value is not null and not a [Date](#) object throw a [TypeError](#) exception; otherwise if the new value is null or a [Date](#) object representing the NaN time value, then set the [value](#) of the element to the empty string; otherwise, run the [algorithm to convert a Date object to a string](#), as defined for that state, on the new value, and set the [value](#) of the element to the resulting string.

The **valueAsNumber** IDL attribute represents the [value](#) of the element, interpreted as a number.

On getting, if the [valueAsNumber](#) attribute [does not apply](#), as defined for the [input](#) element's [type](#) attribute's current state, then return a Not-a-Number (NaN) value. Otherwise, run the [algorithm to convert a string to a number](#) defined for that state to the element's [value](#); if the algorithm returned a number, then return it, otherwise, return a Not-a-Number (NaN) value.

On setting, if the new value is infinite, then throw a [TypeError](#) exception. Otherwise, if the [valueAsNumber](#) attribute [does not apply](#), as defined for the [input](#) element's [type](#) attribute's current state, then throw an ["InvalidStateError" DOMException](#). Otherwise, if the new value is a Not-a-Number (NaN) value, then set the [value](#) of the element to the empty string. Otherwise, run the [algorithm to convert a number to a string](#), as defined for that state, on the new value, and set the [value](#) of the element to the resulting string.

The **stepDown(n)** and **stepUp(n)** methods, when invoked, must run the following algorithm:

1. If the [stepDown\(\)](#) and [stepUp\(\)](#) methods [do not apply](#), as defined for the [input](#) element's [type](#) attribute's current state, then throw an ["InvalidStateError" DOMException](#).

2. If the element has no [allowed value step](#), then throw an ["InvalidStateError"](#) [DOMException](#).
3. If the element has a [minimum](#) and a [maximum](#) and the [minimum](#) is greater than the [maximum](#), then return.
4. If the element has a [minimum](#) and a [maximum](#) and there is no value greater than or equal to the element's [minimum](#) and less than or equal to the element's [maximum](#) that, when subtracted from the [step base](#), is an integral multiple of the [allowed value step](#), then return.
5. If applying the [algorithm to convert a string to a number](#) to the string given by the element's [value](#) does not result in an error, then let *value* be the result of that algorithm. Otherwise, let *value* be zero.
6. Let *valueBeforeStepping* be *value*.
7. If *value* subtracted from the [step base](#) is not an integral multiple of the [allowed value step](#), then set *value* to the nearest value that, when subtracted from the [step base](#), is an integral multiple of the [allowed value step](#), and that is less than *value* if the method invoked was the [stepDown\(\)](#) method, and more than *value* otherwise.

Otherwise (*value* subtracted from the [step base](#) is an integral multiple of the [allowed value step](#)):

1. Let *n* be the argument.
2. Let *delta* be the [allowed value step](#) multiplied by *n*.
3. If the method invoked was the [stepDown\(\)](#) method, negate *delta*.
4. Let *value* be the result of adding *delta* to *value*.
8. If the element has a [minimum](#), and *value* is less than that [minimum](#), then set *value* to the smallest value that, when subtracted from the [step base](#), is an integral multiple of the [allowed value step](#), and that is more than or equal to [minimum](#).
9. If the element has a [maximum](#), and *value* is greater than that [maximum](#), then set *value* to the largest value that, when subtracted from the [step base](#), is an integral multiple of the [allowed value step](#), and that is less than or equal to [maximum](#).
10. If either the method invoked was the [stepDown\(\)](#) method and *value* is greater than *valueBeforeStepping*, or the method invoked was the [stepUp\(\)](#) method and *value* is less than *valueBeforeStepping*, then return.

This ensures that invoking the [stepUp\(\)](#) method on the [input](#) element in the following example does not change the [value](#) of that element:

```
<input type=number value=1 max=0>
```

11. Let *value as string* be the result of running the [algorithm to convert a number to a string](#), as defined for the [input](#) element's [type](#) attribute's current state, on *value*.
 12. Set the [value](#) of the element to *value as string*.
-

The *list* IDL attribute must return the current [suggestions source element](#), if any, or null otherwise.

4.10.5.5 Common event behaviors

When the [input](#) and [change](#) events [apply](#) (which is the case for all [input](#) controls other than [buttons](#) and those with the [type](#) attribute in the [Hidden](#) state), the events are fired to indicate that the user has interacted with the control. The [input](#) event fires whenever the user has modified the data of the control. The [change](#) event fires when the value is committed, if that makes sense for the control, or else when the control [loses focus](#). In all cases, the [input](#) event comes before the corresponding [change](#) event (if any).

When an [input](#) element has a defined [input activation behavior](#), the rules for dispatching these events, if they [apply](#), are given in the section above that defines the [type](#) attribute's state. (This is the case for all [input](#) controls with the [type](#) attribute in the [Checkbox](#) state, the [Radio Button](#) state, or the [File Upload](#) state.)

For [input](#) elements without a defined [input activation behavior](#), but to which these events [apply](#), and for which the user interface involves both interactive manipulation and an explicit commit action, then when the user changes the element's [value](#), the user agent must [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to [fire an event](#) named [input](#) at the [input](#) element, with the [bubbles](#) and [composed](#) attributes initialized to true, and any time the user commits the change, the user agent must [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to [fire an event](#) named [change](#) at the [input](#) element, with the [bubbles](#) attribute initialized to true.

An example of a user interface involving both interactive manipulation and a commit action would be a [Range](#) controls that use a slider, when manipulated using a pointing device. While the user is dragging the control's knob, [input](#) events would fire whenever the position changed, whereas the [change](#) event would only fire when the user let go of the knob, committing to a specific value.

For [input](#) elements without a defined [input activation behavior](#), but to which these events [apply](#), and for which the user interface involves an explicit commit action but no intermediate manipulation, then any time the user commits a change to the element's [value](#), the user agent must [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to first [fire an event](#) named [input](#) at the [input](#) element, with the [bubbles](#) and [composed](#) attributes initialized to true, and then [fire an event](#) named [change](#) at the [input](#) element, with the

[bubbles](#) attribute initialized to true.

An example of a user interface with a commit action would be a [Color](#) control that consists of a single button that brings up a color wheel: if the [value](#) only changes when the dialog is closed, then that would be the explicit commit action. On the other hand, if manipulating the control changes the color interactively, then there might be no commit action.

Another example of a user interface with a commit action would be a [Date](#) control that allows both text-based user input and user selection from a drop-down calendar: while text input might not have an explicit commit step, selecting a date from the drop down calendar and then dismissing the drop down would be a commit action.

For [input](#) elements without a defined [input activation behavior](#), but to which these events [apply](#), any time the user causes the element's [value](#) to change without an explicit commit action, the user agent must [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to [fire an event](#) named [input](#) at the [input](#) element, with the [bubbles](#) and [composed](#) attributes initialized to true. The corresponding [change](#) event, if any, will be fired when the control [loses focus](#).

Examples of a user changing the element's [value](#) would include the user typing into a text control, pasting a new value into the control, or undoing an edit in that control. Some user interactions do not cause changes to the value, e.g., hitting the "delete" key in an empty text control, or replacing some text in the control with text from the clipboard that happens to be exactly the same text.

A [Range](#) control in the form of a slider that the user has [focused](#) and is interacting with using a keyboard would be another example of the user changing the element's [value](#) without a commit step.

In the case of [tasks](#) that just fire an [input](#) event, user agents may wait for a suitable break in the user's interaction before [queuing](#) the tasks; for example, a user agent could wait for the user to have not hit a key for 100ms, so as to only fire the event when the user pauses, instead of continuously for each keystroke.

When the user agent is to change an [input](#) element's [value](#) on behalf of the user (e.g. as part of a form prefilling feature), the user agent must [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to first update the [value](#) accordingly, then [fire an event](#) named [input](#) at the [input](#) element, with the [bubbles](#) and [composed](#) attributes initialized to true, then [fire an event](#) named [change](#) at the [input](#) element, with the [bubbles](#) attribute initialized to true.

These events are not fired in response to changes made to the values of form controls by scripts. (This is to make it easier to update the values of form controls in response to the user manipulating the controls, without having to then filter out the script's own changes to avoid an infinite loop.)

These events are also not fired when the browser changes the values of form controls as part of

[state restoration during navigation.](#)

4.10.6 The **button** element

✓MDN

[Element/button](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLButtonElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Interactive content.](#)

[Listed](#), [labelable](#), [submittable](#), and [autocapitalize-inheriting form-associated element](#).

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

Phrasing content, but there must be no [interactive content](#) descendant and no descendant with the [tabindex](#) attribute specified.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[**disabled**](#) — Whether the form control is disabled

[**form**](#) — Associates the element with a [form](#) element

[**formaction**](#) — [URL](#) to use for [form submission](#)

[**formenctype**](#) — Entry list encoding type to use for [form submission](#)

[**formmethod**](#) — Variant to use for [form submission](#)

[**formnovalidate**](#) — Bypass form control validation for [form submission](#)

[**formtarget**](#) — [Browsing context](#) for [form submission](#)

[**name**](#) — Name of the element to use for [form submission](#) and in the [form.elements](#) API

[**type**](#) — Type of button

[**value**](#) — Value to be used for [form submission](#)

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLButtonElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute boolean disabled;
  readonly attribute HTMLFormElement? form;
  [CEReactions] attribute USVString formAction;
  [CEReactions] attribute DOMString formEnctype;
  [CEReactions] attribute DOMString formMethod;
  [CEReactions] attribute boolean formNoValidate;
  [CEReactions] attribute DOMString formTarget;
  [CEReactions] attribute DOMString name;
  [CEReactions] attribute DOMString type;
  [CEReactions] attribute DOMString value;

  readonly attribute boolean willValidate;
  readonly attribute ValidityState validity;
  readonly attribute DOMString validationMessage;
  boolean checkValidity();
```

```
boolean reportValidity\(\);  
undefined setCustomValidity(DOMString error);  
  
readonly attribute NodeList labels;  
};
```

The [button](#) element [represents](#) a button labeled by its contents.

The element is a [button](#).

The [type](#) attribute controls the behavior of the button when it is activated. It is an [enumerated attribute](#). The following table lists the keywords and states for the attribute — the keywords in the left column map to the states in the cell in the second column on the same row as the keyword.

Keyword	State	Brief description
submit	Submit Button	Submits the form.
reset	Reset Button	Resets the form.
button	Button	Does nothing.

The [missing value default](#) and [invalid value default](#) are the [Submit Button](#) state.

If the [type](#) attribute is in the [Submit Button](#) state, the element is specifically a [submit button](#).

Constraint validation: If the [type](#) attribute is in the [Reset Button](#) state or the [Button](#) state, the element is [barred from constraint validation](#).

A [button](#) element *element's activation behavior* is:

1. If *element* is [disabled](#), then return.
2. If *element* does not have a [form owner](#), then return.
3. If *element's node document* is not [fully active](#), then return.
4. Switch on *element's type* attribute's state:

Submit Button

[Submit](#) *element's form owner* from *element*.

Reset Button

[Reset](#) *element's form owner*.

Button

Do nothing.

The [form](#) attribute is used to explicitly associate the [button](#) element with its [form owner](#). The [name](#) attribute represents the element's name. The [disabled](#) attribute is used to make the control non-interactive and to prevent its value from being submitted. The [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), and [formtarget](#) attributes are [attributes for form submission](#).

The [formnovalidate](#) attribute can be used to make submit buttons that do not trigger the constraint validation.

The [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), and [formtarget](#) must not be specified if the element's [type](#) attribute is not in the [Submit Button](#) state.

The [value](#) attribute gives the element's value for the purposes of form submission. The element's [value](#) is the value of the element's [value](#) attribute, if there is one, or the empty string otherwise.

A button (and its value) is only included in the form submission if the button itself was used to initiate the form submission.

The [value](#) IDL attribute must [reflect](#) the content attribute of the same name.

The [type](#) IDL attribute must [reflect](#) the content attribute of the same name, [limited to only known values](#).

The [willValidate](#), [validity](#), and [validationMessage](#) IDL attributes, and the [checkValidity\(\)](#), [reportValidity\(\)](#), and [setCustomValidity\(\)](#) methods, are part of the [constraint validation API](#). The [labels](#) IDL attribute provides a list of the element's [labels](#). The [disabled](#), [form](#), and [name](#) IDL attributes are part of the element's forms API.

The following button is labeled "Show hint" and pops up a dialog box when activated:

```
<button type=button  
        onclick="alert('This 15-20 minute piece was composed by George Gershwin')  
        Show hint  
</button>
```

4.10.7 The **select** element



[Element/select](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

✓MDN

[HTMLSelectElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 2+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 1+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Categories:

[Flow content](#).

[Phrasing content](#).

[Interactive content](#).

[Listed](#), [labelable](#), [submittable](#), [resettable](#), and [autocapitalize-inheriting form-associated element](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

Zero or more [option](#), [optgroup](#), and [script-supporting](#) elements.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[autocomplete](#) — Hint for form autofill feature

[disabled](#) — Whether the form control is disabled

[form](#) — Associates the element with a [form](#) element

[multiple](#) — Whether to allow multiple values

[name](#) — Name of the element to use for [form submission](#) and in the [form.elements](#) API

[required](#) — Whether the control is required for [form submission](#)

[size](#) — Size of the control

[Accessibility considerations:](#)

If the element has a [multiple](#) attribute or a [size](#) attribute with a value > 1: [for authors](#); [for implementers](#).

Otherwise: [for authors](#); [for implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLSelectElement : HTMLElement {
    [HTMLConstructor] constructor();

    [CEReactions] attribute DOMString autocomplete;
    [CEReactions] attribute boolean disabled;
    readonly attribute HTMLFormElement? form;
    [CEReactions] attribute boolean multiple;
    [CEReactions] attribute DOMString name;
    [CEReactions] attribute boolean required;
    [CEReactions] attribute unsigned long size;

    readonly attribute DOMString type;

    [SameObject] readonly attribute HTMLCollection options;
    [CEReactions] attribute unsigned long length;
    getter HTMLOptionElement? item(unsigned long index);
    HTMLOptionElement? namedItem(DOMString name);
    [CEReactions] undefined add((HTMLOptionElement or HTMLoptGroupElement) e);
    [CEReactions] undefined remove(); // ChildNode overload
    [CEReactions] undefined remove(long index);
    [CEReactions] setter undefined (unsigned long index, HTMLOptionElement? v);

    [SameObject] readonly attribute HTMLCollection selectedOptions;
    attribute long selectedIndex;
    attribute DOMString value;

    readonly attribute boolean willValidate;
    readonly attribute ValidityState validity;
    readonly attribute DOMString validationMessage;
    boolean checkValidity();
    boolean reportValidity();
```

```
undefined setCustomValidity(DOMString error);  
readonly attribute NodeList labels;  
};
```

The [select](#) element represents a control for selecting amongst a set of options.

The [multiple](#) attribute is a [boolean attribute](#). If the attribute is present, then the [select](#) element [represents](#) a control for selecting zero or more options from the [list of options](#). If the attribute is absent, then the [select](#) element [represents](#) a control for selecting a single option from the [list of options](#).

The [size](#) attribute gives the number of options to show to the user. The [size](#) attribute, if specified, must have a value that is a [valid non-negative integer](#) greater than zero.

The *display size* of a [select](#) element is the result of applying the [rules for parsing non-negative integers](#) to the value of element's [size](#) attribute, if it has one and parsing it is successful. If applying those rules to the attribute's value is not successful, or if the [size](#) attribute is absent, then the element's [display size](#) is 4 if the element's [multiple](#) content attribute is present, and 1 otherwise.

The *list of options* for a [select](#) element consists of all the [option](#) element children of the [select](#) element, and all the [option](#) element children of all the [optgroup](#) element children of the [select](#) element, in [tree order](#).

The [required](#) attribute is a [boolean attribute](#). When specified, the user will be required to select a value before submitting the form.

If a [select](#) element has a [required](#) attribute specified, does not have a [multiple](#) attribute specified, and has a [display size](#) of 1; and if the [value](#) of the first [option](#) element in the [select](#) element's [list of options](#) (if any) is the empty string, and that [option](#) element's parent node is the [select](#) element (and not an [optgroup](#) element), then that [option](#) is the [select](#) element's *placeholder label option*.

If a [select](#) element has a [required](#) attribute specified, does not have a [multiple](#) attribute specified, and has a [display size](#) of 1, then the [select](#) element must have a [placeholder label option](#).

In practice, the requirement stated in the paragraph above can only apply when a [select](#) element does not have a [size](#) attribute with a value greater than 1.

Constraint validation: If the element has its [required](#) attribute specified, and either none of the [option](#) elements in the [select](#) element's [list of options](#) have their [selectedness](#) set to true, or the only [option](#) element in the [select](#) element's [list of options](#) with its [selectedness](#) set to true is the [placeholder label option](#), then the element is [suffering from being missing](#).

If the [multiple](#) attribute is absent, and the element is not [disabled](#), then the user agent should

allow the user to pick an **option** element in its **list of options** that is itself not **disabled**. Upon this **option** element being *picked* (either through a click, or through unfocusing the element after changing its value, or through a **menu command**, or through any other mechanism), and before the relevant user interaction event is queued (e.g. before the **click** event), the user agent must set the **selectedness** of the picked **option** element to true, set its **dirtiness** to true, and then **send select update notifications**.

If the **multiple** attribute is absent, whenever an **option** element in the **select** element's **list of options** has its **selectedness** set to true, and whenever an **option** element with its **selectedness** set to true is added to the **select** element's **list of options**, the user agent must set the **selectedness** of all the other **option** elements in its **list of options** to false.

If the **multiple** attribute is absent and the element's **display size** is greater than 1, then the user agent should also allow the user to request that the **option** whose **selectedness** is true, if any, be unselected. Upon this request being conveyed to the user agent, and before the relevant user interaction event is queued (e.g. before the **click** event), the user agent must set the **selectedness** of that **option** element to false, set its **dirtiness** to true, and then **send select update notifications**.

If **nodes are inserted** or **nodes are removed** causing the **list of options** to gain or lose one or more **option** elements, or if an **option** element in the **list of options** *asks for a reset*, then, if the **select** element's **multiple** attribute is absent, the user agent must run the first applicable set of steps from the following list:

If the **select** element's **display size** is 1, and no **option** elements in the **select** element's **list of options** have their **selectedness** set to true

Set the **selectedness** of the first **option** element in the **list of options** in **tree order** that is not **disabled**, if any, to true.

If two or more **option** elements in the **select** element's **list of options** have their **selectedness** set to true

Set the **selectedness** of all but the last **option** element with its **selectedness** set to true in the **list of options** in **tree order** to false.

If the **multiple** attribute is present, and the element is not **disabled**, then the user agent should allow the user to *toggle* the **selectedness** of the **option** elements in its **list of options** that are themselves not **disabled**. Upon such an element being *toggled* (either through a click, or through a **menu command**, or any other mechanism), and before the relevant user interaction event is queued (e.g. before a related **click** event), the **selectedness** of the **option** element must be changed (from true to false or false to true), the **dirtiness** of the element must be set to true, and the user agent must **send select update notifications**.

When the user agent is to *send select update notifications*, **queue an element task** on the **user interaction task source** given the **select** element to run these steps:

1. [Fire an event](#) named `input` at the `select` element, with the `bubbles` and `composed` attributes initialized to true.
2. [Fire an event](#) named `change` at the `select` element, with the `bubbles` attribute initialized to true.

The [reset algorithm](#) for `select` elements is to go through all the `option` elements in the element's [list of options](#), set their [selectedness](#) to true if the `option` element has a `selected` attribute, and false otherwise, set their [dirtiness](#) to false, and then have the `option` elements [ask for a reset](#).

The `form` attribute is used to explicitly associate the `select` element with its [form owner](#). The `name` attribute represents the element's name. The `disabled` attribute is used to make the control non-interactive and to prevent its value from being submitted. The `autocomplete` attribute controls how the user agent provides autofill behavior.

A `select` element that is not `disabled` is [mutable](#).

`select.type`

✓MDN

[HTMLSelectElement/type](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 2+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 1+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns "select-multiple" if the element has a [multiple](#) attribute, and "select-one" otherwise.

`select.options`

✓MDN

[HTMLSelectElement/options](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns an [HTMLOptionsCollection](#) of the [list of options](#).

`select.length [= value]`

Returns the number of elements in the [list of options](#).

When set to a smaller number, truncates the number of [option](#) elements in the [select](#).

When set to a greater number, adds new blank [option](#) elements to the [select](#).

`element = select.item(index)`

✓MDN

[HTMLSelectElement/item](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

`select[index]`

Returns the item with index *index* from the [list of options](#). The items are sorted in [tree order](#).

`element = select.namedItem(name)`

✓MDN

[HTMLSelectElement/namedItem](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer6+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Returns the first item with [ID](#) or [name](#) name from the [list of options](#).

Returns null if no element with that [ID](#) could be found.

`select.add(element [, before])`

✓MDN

[HTMLSelectElement/add](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Inserts *element* before the node given by *before*.

The *before* argument can be a number, in which case *element* is inserted before the item with that number, or an element from the [list of options](#), in which case *element* is inserted before that element.

If *before* is omitted, null, or a number out of range, then *element* will be added at the end of the list.

This method will throw a "[HierarchyRequestError](#)" [DOMException](#) if *element* is an ancestor of the element into which it is to be inserted.

`select.selectedOptions`

✓MDN

[HTMLSelectElement/selectedOptions](#)

Support in all current engines.

Firefox26+Safari6+Chrome19+

Opera9+Edge79+

Edge (Legacy)12+Internet ExplorerNo

Firefox Android26+Safari iOS6+Chrome Android25+WebView Android37+Samsung

Internet1.5+Opera Android10.1+

Returns an [HTMLCollection](#) of the [list of options](#) that are selected.

`select.selectedIndex [= value]`

✓MDN

[HTMLSelectElement/selectedIndex](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns the index of the first selected item, if any, or `-1` if there is no selected item.

Can be set, to change the selection.

`select.value [= value]`

Returns the [value](#) of the first selected item, if any, or the empty string if there is no selected item.

Can be set, to change the selection.

The [type](#) IDL attribute, on getting, must return the string "`select-one`" if the [multiple](#) attribute is absent, and the string "`select-multiple`" if the [multiple](#) attribute is present.

The [options](#) IDL attribute must return an [HTMLOptionsCollection](#) rooted at the [select](#) node, whose filter matches the elements in the [list of options](#).

The [options](#) collection is also mirrored on the [HTMLSelectElement](#) object. The [supported property indices](#) at any instant are the indices supported by the object returned by the [options](#) attribute at that instant.

The [length](#) IDL attribute must return the number of nodes [represented](#) by the [options](#) collection. On setting, it must act like the attribute of the same name on the [options](#) collection.

The [item\(index\)](#) method must return the value returned by [the method of the same name](#) on the [options](#) collection, when invoked with the same argument.

The [namedItem\(name\)](#) method must return the value returned by [the method of the same name](#) on the [options](#) collection, when invoked with the same argument.

When the user agent is to [set the value of a new indexed property](#) or [set the value of an existing indexed property](#) for a [**select**](#) element, it must instead run [the corresponding algorithm](#) on the [**select**](#) element's [**options**](#) collection.

Similarly, the [*add\(element, before\)*](#) method must act like its namesake method on that same [**options**](#) collection.



[HTMLSelectElement/remove](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

The [*remove\(\)*](#) method must act like its namesake method on that same [**options**](#) collection when it has arguments, and like its namesake method on the [**ChildNode**](#) interface implemented by the [**HTMLSelectElement**](#) ancestor interface [**Element**](#) when it has no arguments.

The [**selectedOptions**](#) IDL attribute must return an [**HTMLCollection**](#) rooted at the [**select**](#) node, whose filter matches the elements in the [list of options](#) that have their [**selectedness**](#) set to true.

The [**selectedIndex**](#) IDL attribute, on getting, must return the [**index**](#) of the first [**option**](#) element in the [list of options](#) in [tree order](#) that has its [**selectedness**](#) set to true, if any. If there isn't one, then it must return -1.

On setting, the [**selectedIndex**](#) attribute must set the [**selectedness**](#) of all the [**option**](#) elements in the [list of options](#) to false, and then the [**option**](#) element in the [list of options](#) whose [**index**](#) is the given new value, if any, must have its [**selectedness**](#) set to true and its [**dirtiness**](#) set to true.

This can result in no element having a [**selectedness**](#) set to true even in the case of the [**select**](#) element having no [**multiple**](#) attribute and a [**display size**](#) of 1.

The [**value**](#) IDL attribute, on getting, must return the [**value**](#) of the first [**option**](#) element in the [list of options](#) in [tree order](#) that has its [**selectedness**](#) set to true, if any. If there isn't one, then it must return the empty string.

On setting, the [**value**](#) attribute must set the [**selectedness**](#) of all the [**option**](#) elements in the [list of options](#) to false, and then the first [**option**](#) element in the [list of options](#), in [tree order](#), whose [**value**](#) is equal to the given new value, if any, must have its [**selectedness**](#) set to true and its

[dirtiness](#) set to true.

This can result in no element having a [selectedness](#) set to true even in the case of the [select](#) element having no [multiple](#) attribute and a [display size](#) of 1.

The *multiple*, *required*, and *size* IDL attributes must [reflect](#) the respective content attributes of the same name. The [size](#) IDL attribute has a default value of zero.

For historical reasons, the default value of the [size](#) IDL attribute does not return the actual size used, which, in the absence of the [size](#) content attribute, is either 1 or 4 depending on the presence of the [multiple](#) attribute.

The [willValidate](#), [validity](#), and [validationMessage](#) IDL attributes, and the [checkValidity\(\)](#), [reportValidity\(\)](#), and [setCustomValidity\(\)](#) methods, are part of the [constraint validation API](#). The [labels](#) IDL attribute provides a list of the element's [label](#)s. The [disabled](#), [form](#), and [name](#) IDL attributes are part of the element's forms API.

The following example shows how a [select](#) element can be used to offer the user with a set of options from which the user can select a single option. The default option is preselected.

```
<p>
  <label for="unittype">Select unit type:</label>
  <select id="unittype" name="unittype">
    <option value="1"> Miner </option>
    <option value="2"> Puffer </option>
    <option value="3" selected> Snipey </option>
    <option value="4"> Max </option>
    <option value="5"> Firebot </option>
  </select>
</p>
```

When there is no default option, a placeholder can be used instead:

```
<select name="unittype" required>
  <option value=""> Select unit type </option>
  <option value="1"> Miner </option>
  <option value="2"> Puffer </option>
  <option value="3"> Snipey </option>
  <option value="4"> Max </option>
  <option value="5"> Firebot </option>
</select>
```

Here, the user is offered a set of options from which they can select any number. By default, all five options are selected.

```
<p>
  <label for="allowedunits">Select unit types to enable on this map:</label>
```

```

<select id="allowedunits" name="allowedunits" multiple>
  <option value="1" selected> Miner </option>
  <option value="2" selected> Puffer </option>
  <option value="3" selected> Snipey </option>
  <option value="4" selected> Max </option>
  <option value="5" selected> Firebot </option>
</select>
</p>

```

Sometimes, a user has to select one or more items. This example shows such an interface.

```

<label>
  Select the songs from that you would like on your Act II Mix Tape:
  <select multiple required name="act2">
    <option value="s1">It Sucks to Be Me (Reprise)
    <option value="s2">There is Life Outside Your Apartment
    <option value="s3">The More You Ruv Someone
    <option value="s4">Schadenfreude
    <option value="s5">I Wish I Could Go Back to College
    <option value="s6">The Money Song
    <option value="s7">School for Monsters
    <option value="s8">The Money Song (Reprise)
    <option value="s9">There's a Fine, Fine Line (Reprise)
    <option value="s10">What Do You Do With a B.A. in English? (Reprise)
    <option value="s11">For Now
  </select>
</label>

```

4.10.8 The **datalist** element



[Element/datalist](#)

Support in all current engines.

Firefox 4+ Safari 12.1+ Chrome 20+

Opera 9.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 12.2+ Chrome Android 33+ WebView Android 4.4.3+ Samsung

Internet 2.0+ Opera Android Yes



[HTMLDataListElement](#)

Support in all current engines.

Firefox4+Safari12.1+Chrome20+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android4+Safari iOS12.2+Chrome Android25+WebView Android37+Samsung Internet1.5+Opera Android12.1+

Categories:

[Flow content](#).

[Phrasing content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

Either: [phrasing content](#).

Or: Zero or more [option](#) and [script-supporting](#) elements.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLDataListElement : HTMLElement {
  [HTMLConstructor] constructor();

  [SameObject] readonly attribute HTMLCollection options;
};
```

The [datalist](#) element represents a set of [option](#) elements that represent predefined options for other controls. In the rendering, the [datalist](#) element [represents](#) nothing and it, along with its children, should be hidden.

The [datalist](#) element can be used in two ways. In the simplest case, the [datalist](#) element has just [option](#) element children.

```
<label>
  Animal:
<input name=animal list=animals>
```

```
<datalist id=animals>
  <option value="Cat">
  <option value="Dog">
</datalist>
</label>
```

In the more elaborate case, the [datalist](#) element can be given contents that are to be displayed for down-level clients that don't support [datalist](#). In this case, the [option](#) elements are provided inside a [select](#) element inside the [datalist](#) element.

```
<label>
  Animal:
  <input name=animal list=animals>
</label>
<datalist id=animals>
  <label>
    or select from the list:
    <select name=animal>
      <option value="">
      <option>Cat
      <option>Dog
    </select>
  </label>
</datalist>
```

The [datalist](#) element is hooked up to an [input](#) element using the [list](#) attribute on the [input](#) element.

Each [option](#) element that is a descendant of the [datalist](#) element, that is not [disabled](#), and whose [value](#) is a string that isn't the empty string, represents a suggestion. Each suggestion has a [value](#) and a [label](#).

alist.options

Returns an [HTMLCollection](#) of the [option](#) elements of the [alist](#) element.

The [options](#) IDL attribute must return an [HTMLCollection](#) rooted at the [alist](#) node, whose filter matches [option](#) elements.

Constraint validation: If an element has a [alist](#) element ancestor, it is [barred from constraint validation](#).

4.10.9 The **optgroup** element

[Element/optgroup](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓ MDN

[HTML OptGroup Element](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As a child of a [select](#) element.

[Content model:](#)

Zero or more [option](#) and [script-supporting](#) elements.

[Tag omission in text/html:](#)

An [optgroup](#) element's [end tag](#) can be omitted if the [optgroup](#) element is immediately followed by another [optgroup](#) element, or if there is no more content in the parent element.

[Content attributes:](#)

[Global attributes](#)

[disabled](#) — Whether the form control is disabled

[label](#) — User-visible label

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLOptGroupElement : HTMLElement {
    [HTMLConstructor] constructor();

    [CEReactions] attribute boolean disabled;
    [CEReactions] attribute DOMString label;
};
```

The [optgroup](#) element [represents](#) a group of [option](#) elements with a common label.

The element's group of [option](#) elements consists of the [option](#) elements that are children of the [optgroup](#) element.

When showing [option](#) elements in [select](#) elements, user agents should show the [option](#) elements of such groups as being related to each other and separate from other [option](#) elements.

The ***disabled*** attribute is a [boolean attribute](#) and can be used to [disable](#) a group of [option](#) elements together.

The ***label*** attribute must be specified. Its value gives the name of the group, for the purposes of the user interface. User agents should use this attribute's value when labeling the group of [option](#) elements in a [select](#) element.

The ***disabled*** and ***label*** attributes must [reflect](#) the respective content attributes of the same name.

There is no way to select an [optgroup](#) element. Only [option](#) elements can be selected. An [optgroup](#) element merely provides a label for a group of [option](#) elements.

The following snippet shows how a set of lessons from three courses could be offered in a [select](#) drop-down widget:

```
<form action="coursesselector.dll" method="get">
<p>Which course would you like to watch today?
<p><label>Course:
<select name="c">
    <optgroup label="8.01 Physics I: Classical Mechanics">
        <option value="8.01.1">Lecture 01: Powers of Ten
        <option value="8.01.2">Lecture 02: 1D Kinematics
        <option value="8.01.3">Lecture 03: Vectors
    <optgroup label="8.02 Electricity and Magnetism">
        <option value="8.02.1">Lecture 01: What holds our world together?
        <option value="8.02.2">Lecture 02: Electric Field
        <option value="8.02.3">Lecture 03: Electric Flux
```

```
<optgroup label="8.03 Physics III: Vibrations and Waves">
  <option value="8.03.1">Lecture 01: Periodic Phenomenon
  <option value="8.03.2">Lecture 02: Beats
  <option value="8.03.3">Lecture 03: Forced Oscillations with Damping
</select>
</label>
<p><input type=submit value="▶ Play">
</form>
```

4.10.10 The **option** element

✓MDN

[Element/option](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

✓MDN

[HTMLOptionElement](#)

Support in all current engines.

Firefox 1+ Safari 1.2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As a child of a [select](#) element.

As a child of a [datalist](#) element.

As a child of an [optgroup](#) element.

[Content model:](#)

If the element has a [label](#) attribute and a [value](#) attribute: [Nothing](#).

If the element has a [label](#) attribute but no [value](#) attribute: [Text](#).

If the element has no [label](#) attribute and is not a child of a [datalist](#) element: [Text](#) that is not [inter-element whitespace](#).

If the element has no [label](#) attribute and is a child of a [datalist](#) element: [Text](#).

[Tag omission in text/html:](#)

An [option](#) element's [end tag](#) can be omitted if the [option](#) element is immediately followed by another [option](#) element, or if it is immediately followed by an [optgroup](#) element, or if there is no more content in the parent element.

[Content attributes:](#)

[Global attributes](#)

[disabled](#) — Whether the form control is disabled

[label](#) — User-visible label

[selected](#) — Whether the option is selected by default

[value](#) — Value to be used for [form submission](#)

[Accessibility considerations:](#)

[For authors](#)

[For implementers](#)

[DOM interface:](#)

```
[Exposed=Window,
LegacyFactoryFunction=Option(optional DOMString text = "", optional DOMString
interface HTMLOptionElement : HTMLElement {
    HTMLConstructor constructor();

    [CEReactions] attribute boolean disabled;
    readonly attribute HTMLFormElement? form;
    [CEReactions] attribute DOMString label;
    [CEReactions] attribute boolean defaultSelected;
    attribute boolean selected;
    [CEReactions] attribute DOMString value;

    [CEReactions] attribute DOMString text;
    readonly attribute long index;
};
```

The [option](#) element [represents](#) an option in a [select](#) element or as part of a list of suggestions in a [datalist](#) element.

In certain circumstances described in the definition of the [select](#) element, an [option](#) element can be a [select](#) element's [placeholder label option](#). A [placeholder label option](#) does not represent an actual option, but instead represents a label for the [select](#) control.

The **disabled** attribute is a [boolean attribute](#). An [option](#) element is *disabled* if its [disabled](#) attribute is present or if it is a child of an [optgroup](#) element whose [disabled](#) attribute is present.

An [option](#) element that is [disabled](#) must prevent any [click](#) events that are [queued](#) on the [user interaction task source](#) from being dispatched on the element.

The **label** attribute provides a label for element. The *label* of an [option](#) element is the value of the [label](#) content attribute, if there is one and its value is not the empty string, or, otherwise, the value of the element's [text](#) IDL attribute.

The [label](#) content attribute, if specified, must not be empty.

The **value** attribute provides a value for element. The *value* of an [option](#) element is the value of the [value](#) content attribute, if there is one, or, if there is not, the value of the element's [text](#) IDL attribute.

The **selected** attribute is a [boolean attribute](#). It represents the default [selectedness](#) of the element.

The *dirtiness* of an [option](#) element is a boolean state, initially false. It controls whether adding or removing the [selected](#) content attribute has any effect.

The *selectedness* of an [option](#) element is a boolean state, initially false. Except where otherwise specified, when the element is created, its [selectedness](#) must be set to true if the element has a [selected](#) attribute. Whenever an [option](#) element's [selected](#) attribute is added, if its [dirtiness](#) is false, its [selectedness](#) must be set to true. Whenever an [option](#) element's [selected](#) attribute is removed, if its [dirtiness](#) is false, its [selectedness](#) must be set to false.

The [Option\(\)](#) constructor, when called with three or fewer arguments, overrides the initial state of the [selectedness](#) state to always be false even if the third argument is true (implying that a [selected](#) attribute is to be set). The fourth argument can be used to explicitly set the initial [selectedness](#) state when using the constructor.

A [select](#) element whose [multiple](#) attribute is not specified must not have more than one descendant [option](#) element with its [selected](#) attribute set.

An [option](#) element's *index* is the number of [option](#) elements that are in the same [list of options](#) but that come before it in [tree order](#). If the [option](#) element is not in a [list of options](#), then the [option](#) element's [index](#) is zero.

`option.selected`

Returns true if the element is selected, and false otherwise.

Can be set, to override the current state of the element.

`option.index`

Returns the index of the element in its `select` element's `options` list.

`option.form`

Returns the element's `form` element, if any, or null otherwise.

`option.text`

Same as `textContent`, except that spaces are collapsed and `script` elements are skipped.

`option = new Option([text [, value [, defaultSelected [, selected]]])`

✓MDN

[HTMLOptionElement/Option](#)

Support in all current engines.

Firefox 1+ Safari 1.2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns a new `option` element.

The `text` argument sets the contents of the element.

The `value` argument sets the `value` attribute.

The `defaultSelected` argument sets the `selected` attribute.

The `selected` argument sets whether or not the element is selected. If it is omitted, even if the `defaultSelected` argument is true, the element is not selected.

The `disabled` IDL attribute must `reflect` the `content` attribute of the same name. The `defaultSelected` IDL attribute must `reflect` the `selected` content attribute.

The `label` IDL attribute, on getting, if there is a `label` content attribute, must return that attribute's value; otherwise, it must return the element's `label`. On setting, the element's `label` content attribute must be set to the new value.

The `value` IDL attribute, on getting, must return the element's `value`. On setting, the element's `value` content attribute must be set to the new value.

The `selected` IDL attribute, on getting, must return true if the element's `selectedness` is true, and false otherwise. On setting, it must set the element's `selectedness` to the new value, set its `dirtiness` to true, and then cause the element to [ask for a reset](#).

The `index` IDL attribute must return the element's [index](#).

The `text` IDL attribute, on getting, must return the result of [stripping and collapsing ASCII whitespace](#) from the concatenation of `data` of all the `Text` node descendants of the `option` element, in [tree order](#), excluding any that are descendants of descendants of the `option` element that are themselves `script` or [SVG script](#) elements.

The `text` attribute's setter must [string replace all](#) with the given value within this element.

The `form` IDL attribute's behavior depends on whether the `option` element is in a `select` element or not. If the `option` has a `select` element as its parent, or has an `optgroup` element as its parent and that `optgroup` element has a `select` element as its parent, then the `form` IDL attribute must return the same value as the `form` IDL attribute on that `select` element. Otherwise, it must return null.

A legacy factory function is provided for creating `HTMLOptionElement` objects (in addition to the factory methods from DOM such as `createElement(): Option(text, value, defaultSelected, selected)`). When invoked, the legacy factory function must perform the following steps:

1. Let `document` be the [current global object's associated Document](#).
2. Let `option` be the result of [creating an element](#) given `document`, `option`, and the [HTML namespace](#).
3. If `text` is not the empty string, then append to `option` a new `Text` node whose data is `text`.
4. If `value` is given, then [set an attribute value](#) for `option` using "`value`" and `value`.
5. If `defaultSelected` is true, then [set an attribute value](#) for `option` using "`selected`" and the empty string.
6. If `selected` is true, then set `option`'s `selectedness` to true; otherwise set its `selectedness` to false (even if `defaultSelected` is true).

7. Return *option*.

4.10.11 The **textarea** element



[Element/textarea](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes



[HTMLTextAreaElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 8+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Categories:

[Flow content](#).

[Phrasing content](#).

[Interactive content](#).

[Listed](#), [labelable](#), [submittable](#), [resettable](#), and [autocapitalize-inheriting form-associated element](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Text](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

autocomplete — Hint for form autofill feature

cols — Maximum number of characters per line

dirname — Name of form control to use for sending the element's directionality in form submission

disabled — Whether the form control is disabled

form — Associates the element with a form element

maxlength — Maximum length of value

minlength — Minimum length of value

name — Name of the element to use for form submission and in the form.elements API

placeholder — User-visible label to be placed within the form control

readonly — Whether to allow the value to be edited by the user

required — Whether the control is required for form submission

rows — Number of lines to show

wrap — How the value of the form control is to be wrapped for form submission

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLTextAreaElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute DOMString autocomplete;
  [CEReactions] attribute unsigned long cols;
  [CEReactions] attribute DOMString dirName;
  [CEReactions] attribute boolean disabled;
  readonly attribute HTMLFormElement? form;
  [CEReactions] attribute long maxLength;
  [CEReactions] attribute long minLength;
  [CEReactions] attribute DOMString name;
```

```

[CEReactions] attribute DOMString placeholder;
[CEReactions] attribute boolean readOnly;
[CEReactions] attribute boolean required;
[CEReactions] attribute unsigned long rows;
[CEReactions] attribute DOMString wrap;

readonly attribute DOMString type;
[CEReactions] attribute DOMString defaultValue;
attribute [LegacyNullToEmptyString] DOMString value;
readonly attribute unsigned long textLength;

readonly attribute boolean willValidate;
readonly attribute ValidityState validity;
readonly attribute DOMString validationMessage;
boolean checkValidity();
boolean reportValidity();
undefined setCustomValidity(DOMString error);

readonly attribute NodeList labels;

undefined select();
attribute unsigned long selectionStart;
attribute unsigned long selectionEnd;
attribute DOMString selectionDirection;
undefined setRangeText(DOMString replacement);
undefined setRangeText(DOMString replacement, unsigned long start, unsig
undefined setSelectionRange(unsigned long start, unsigned long end, opti
);

```

The `textarea` element represents a multiline plain text edit control for the element's *raw value*. The contents of the control represent the control's default value.

The raw value of a `textarea` control must be initially the empty string.

This element has rendering requirements involving the bidirectional algorithm.

The *readonly* attribute is a boolean attribute used to control whether the text can be edited by the user or not.

In this example, a text control is marked read-only because it represents a read-only file:

```

Filename: <code>/etc/bash.bashrc</code>
<textarea name="buffer" readonly>
# System-wide .bashrc file for interactive bash(1) shells.

# To enable the settings / commands in this file for login shells as well,
# this file has to be sourced in /etc/profile.

```

```
# If not running interactively, don't do anything
[ -z "$PS1" ] && return

...</textarea>
```

Constraint validation: If the [readonly](#) attribute is specified on a [textarea](#) element, the element is [barred from constraint validation](#).

A [textarea](#) element is [mutable](#) if it is neither [disabled](#) nor has a [readonly](#) attribute specified.

When a [textarea](#) is [mutable](#), its [raw value](#) should be editable by the user: the user agent should allow the user to edit, insert, and remove text, and to insert and remove line breaks in the form of U+000A LINE FEED (LF) characters. Any time the user causes the element's [raw value](#) to change, the user agent must [queue an element task](#) on the [user interaction task source](#) given the [textarea](#) element to [fire an event](#) named [input](#) at the [textarea](#) element, with the [bubbles](#) and [composed](#) attributes initialized to true. User agents may wait for a suitable break in the user's interaction before queuing the task; for example, a user agent could wait for the user to have not hit a key for 100ms, so as to only fire the event when the user pauses, instead of continuously for each keystroke.

A [textarea](#) element's [dirty value flag](#) must be set to true whenever the user interacts with the control in a way that changes the [raw value](#).

The [cloning steps](#) for [textarea](#) elements must propagate the [raw value](#) and [dirty value flag](#) from the node being cloned to the copy.

The [children changed steps](#) for [textarea](#) elements must, if the element's [dirty value flag](#) is false, set the element's [raw value](#) to its [child text content](#).

The [reset algorithm](#) for [textarea](#) elements is to set the [dirty value flag](#) back to false, and set the [raw value](#) of element to its [child text content](#).

When a [textarea](#) element is popped off the [stack of open elements](#) of an [HTML parser](#) or [XML parser](#), then the user agent must invoke the element's [reset algorithm](#).

If the element is [mutable](#), the user agent should allow the user to change the writing direction of the element, setting it either to a left-to-right writing direction or a right-to-left writing direction. If the user does so, the user agent must then run the following steps:

1. Set the element's [dir](#) attribute to "[ltr](#)" if the user selected a left-to-right writing direction, and "[rtl](#)" if the user selected a right-to-left writing direction.
2. [Queue an element task](#) on the [user interaction task source](#) given the [textarea](#) element to [fire an event](#) named [input](#) at the [textarea](#) element, with the [bubbles](#) and [composed](#) attributes initialized to true.

The `cols` attribute specifies the expected maximum number of characters per line. If the `cols` attribute is specified, its value must be a [valid non-negative integer](#) greater than zero. If applying the [rules for parsing non-negative integers](#) to the attribute's value results in a number greater than zero, then the element's *character width* is that value; otherwise, it is 20.

The user agent may use the `textarea` element's [character width](#) as a hint to the user as to how many characters the server prefers per line (e.g. for visual user agents by making the width of the control be that many characters). In visual renderings, the user agent should wrap the user's input in the rendering so that each line is no wider than this number of characters.

The `rows` attribute specifies the number of lines to show. If the `rows` attribute is specified, its value must be a [valid non-negative integer](#) greater than zero. If applying the [rules for parsing non-negative integers](#) to the attribute's value results in a number greater than zero, then the element's *character height* is that value; otherwise, it is 2.

Visual user agents should set the height of the control to the number of lines given by [character height](#).

The `wrap` attribute is an [enumerated attribute](#) with two keywords and states: the `soft` keyword which maps to the `Soft` state, and the `hard` keyword which maps to the `Hard` state. The [missing value default](#) and [invalid value default](#) are the `Soft` state.

The `Soft` state indicates that the text in the `textarea` is not to be wrapped when it is submitted (though it can still be wrapped in the rendering).

The `Hard` state indicates that the text in the `textarea` is to have newlines added by the user agent so that the text is wrapped when it is submitted.

If the element's `wrap` attribute is in the `Hard` state, the `cols` attribute must be specified.

For historical reasons, the element's value is normalized in three different ways for three different purposes. The [raw value](#) is the value as it was originally set. It is not normalized. The [API value](#) is the value used in the `value` IDL attribute, `textLength` IDL attribute, and by the `maxlength` and `minlength` content attributes. It is normalized so that line breaks use U+000A LINE FEED (LF) characters. Finally, there is the [value](#), as used in form submission and other processing models in this specification. It is normalized as for the [API value](#), and in addition, if necessary given the element's `wrap` attribute, additional line breaks are inserted to wrap the text at the given width.

The algorithm for obtaining the element's [API value](#) is to return the element's [raw value](#), with [newlines normalized](#).

The element's `value` is defined to be the element's [API value](#) with the [textarea wrapping transformation](#) applied. The *textarea wrapping transformation* is the following algorithm, as applied to a string:

1. If the element's `wrap` attribute is in the `Hard` state, insert U+000A LINE FEED (LF)

characters into the string using an [implementation-defined](#) algorithm so that each line has no more than [character width](#) characters. For the purposes of this requirement, lines are delimited by the start of the string, the end of the string, and U+000A LINE FEED (LF) characters.

The *maxlength* attribute is a [form control maxlength attribute](#).

If the [textarea](#) element has a [maximum allowed value length](#), then the element's children must be such that the [length](#) of the value of the element's [descendant text content](#) with [newlines normalized](#) is equal to or less than the element's [maximum allowed value length](#).

The *minlength* attribute is a [form control minlength attribute](#).

The *required* attribute is a [boolean attribute](#). When specified, the user will be required to enter a value before submitting the form.

Constraint validation: If the element has its [required](#) attribute specified, and the element is [mutable](#), and the element's [value](#) is the empty string, then the element is [suffering from being missing](#).

The *placeholder* attribute represents a *short hint* (a word or short phrase) intended to aid the user with data entry when the control has no value. A hint could be a sample value or a brief description of the expected format.

The [placeholder](#) attribute should not be used as an alternative to a [label](#). For a longer hint or other advisory text, the [title](#) attribute is more appropriate.

These mechanisms are very similar but subtly different: the hint given by the control's [label](#) is shown at all times; the short hint given in the [placeholder](#) attribute is shown before the user enters a value; and the hint in the [title](#) attribute is shown when the user requests further help.

User agents should present this hint to the user when the element's [value](#) is the empty string and the control is not [focused](#) (e.g. by displaying it inside a blank unfocused control). All U+000D CARRIAGE RETURN U+000A LINE FEED character pairs (CRLF) in the hint, as well as all other U+000D CARRIAGE RETURN (CR) and U+000A LINE FEED (LF) characters in the hint, must be treated as line breaks when rendering the hint.

If a user agent normally doesn't show this hint to the user when the control is [focused](#), then the user agent should nonetheless show the hint for the control if it was focused as a result of the [autofocus](#) attribute, since in that case the user will not have had an opportunity to examine the control before focusing it.

The [name](#) attribute represents the element's name. The [dirname](#) attribute controls how the element's [directionality](#) is submitted. The [disabled](#) attribute is used to make the control non-interactive and to prevent its value from being submitted. The [form](#) attribute is used to explicitly associate the [textarea](#) element with its [form owner](#). The [autocomplete](#) attribute

controls how the user agent provides autofill behavior.

`textarea.type`

Returns the string "`textarea`".

`textarea.value`

Returns the current value of the element.

Can be set, to change the value.

The `cols`, `placeholder`, `required`, `rows`, and `wrap` IDL attributes must [reflect](#) the respective content attributes of the same name. The `cols` and `rows` attributes are [limited to only non-negative numbers greater than zero with fallback](#). The `cols` IDL attribute's default value is 20. The `rows` IDL attribute's default value is 2. The `dirName` IDL attribute must [reflect](#) the `dirname` content attribute. The `maxLength` IDL attribute must [reflect](#) the `maxlength` content attribute, [limited to only non-negative numbers](#). The `minLength` IDL attribute must [reflect](#) the `minlength` content attribute, [limited to only non-negative numbers](#). The `readOnly` IDL attribute must [reflect](#) the `readonly` content attribute.

The `type` IDL attribute must return the value "`textarea`".

The `defaultValue` attribute's getter must return the element's [child text content](#).

The `defaultValue` attribute's setter must [string replace all](#) with the given value within this element.

The `value` IDL attribute must, on getting, return the element's [API value](#). On setting, it must perform the following steps:

1. Let `oldAPIValue` be this element's [API value](#).
2. Set this element's [raw value](#) to the new value.
3. Set this element's [dirty value flag](#) to true.
4. If the new [API value](#) is different from `oldAPIValue`, then move the [text entry cursor position](#) to the end of the text control, unselecting any selected text and [resetting the selection direction](#) to "none".

The `textLength` IDL attribute must return the [length](#) of the element's [API value](#).

The `willValidate`, `validity`, and `validationMessage` IDL attributes, and the `checkValidity()`, `reportValidity()`, and `setCustomValidity()` methods, are part of the [constraint validation API](#). The `labels` IDL attribute provides a list of the element's `label`s. The `select()`, `selectionStart`, `selectionEnd`, `selectionDirection`,

[setRangeText\(\)](#), and [setSelectionRange\(\)](#) methods and IDL attributes expose the element's text selection. The [disabled](#), [form](#), and [name](#) IDL attributes are part of the element's forms API.

Here is an example of a [textarea](#) being used for unrestricted free-form text input in a form:

```
<p>If you have any comments, please let us know: <textarea cols=80 name=commen
```

To specify a maximum length for the comments, one can use the [maxlength](#) attribute:

```
<p>If you have any short comments, please let us know: <textarea cols=80 name=
```

To give a default value, text can be included inside the element:

```
<p>If you have any comments, please let us know: <textarea cols=80 name=commen
```

You can also give a minimum length. Here, a letter needs to be filled out by the user; a template (which is shorter than the minimum length) is provided, but is insufficient to submit the form:

```
<textarea required minlength="500">Dear Madam Speaker,
```

Regarding your letter dated ...

...

Yours Sincerely,

```
...</textarea>
```

A placeholder can be given as well, to suggest the basic form to the user, without providing an explicit template:

```
<textarea placeholder="Dear Francine,
```

They closed the parks this week, so we won't be able to
meet you there. Should we just have dinner?

Love,

```
Daddy"></textarea>
```

To have the browser submit [the directionality](#) of the element along with the value, the [dirname](#) attribute can be specified:

```
<p>If you have any comments, please let us know (you may use either English or  
<textarea cols=80 name=comments dirname=comments.dir></textarea></p>
```

4.10.12 The ***output*** element

✓MDN

Element/output

Support in all current engines.

Firefox 4+ Safari 7+ Chrome 10+

Opera 11+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android?

✓MDN

HTMLOutputElement

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 9+

Opera 12.1+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Listed](#), [labelable](#), [resettable](#), and [autocapitalize-inheriting form-associated element](#).

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content.](#)

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

for — Specifies controls from which the output was calculated

[form](#) — Associates the element with a [form](#) element

[name](#) — Name of the element to use in the [form.elements](#) API.

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLOutputElement : HTMLElement {
  HTMLConstructor constructor();

  [SameObject, PutForwards=value] readonly attribute DOMTokenList htmlFor;
  readonly attribute HTMLFormElement? form;
  [CEReactions] attribute DOMString name;

  readonly attribute DOMString type;
  [CEReactions] attribute DOMString defaultValue;
  [CEReactions] attribute DOMString value;

  readonly attribute boolean willValidate;
  readonly attribute ValidityState validity;
  readonly attribute DOMString validationMessage;
  boolean checkValidity();
  boolean reportValidity();
  undefined setCustomValidity(DOMString error);

  readonly attribute NodeList labels;
};
```

The [output](#) element [represents](#) the result of a calculation performed by the application, or the result of a user action.

This element can be contrasted with the [samp](#) element, which is the appropriate element for quoting the output of other programs run previously.

The [for](#) content attribute allows an explicit relationship to be made between the result of a calculation and the elements that represent the values that went into the calculation or that otherwise influenced the calculation. The [for](#) attribute, if specified, must contain a string consisting of an [unordered set of unique space-separated tokens](#), none of which are [identical to](#) another token and each of which must have the value of an [ID](#) of an element in the same [tree](#).

The [form](#) attribute is used to explicitly associate the [output](#) element with its [form owner](#). The [name](#) attribute represents the element's name. The [output](#) element is associated with a form so that it can be easily [referenced](#) from the event handlers of form controls; the element's value

itself is not submitted when the form is submitted.

The element has a *default value override* (null or a string). Initially it must be null.

The element's *default value* is determined by the following steps:

1. If this element's [default value override](#) is non-null, then return it.
2. Return this element's [descendant text content](#).

The [reset algorithm](#) for [output](#) elements is to run these steps:

1. [String replace all](#) with this element's [default value](#) within this element.
2. Set this element's [default value override](#) to null.

[output.value](#) [= **value]**

Returns the element's current value.

Can be set, to change the value.

[output.defaultValue](#) [= **value]**

Returns the element's current default value.

Can be set, to change the default value.

[output.type](#)

Returns the string "output".

The **value** getter steps are to return [this's descendant text content](#).

The **value** setter steps are:

1. Set [this's default value override](#) to its [default value](#).
2. [String replace all](#) with the given value within [this](#).

The **defaultValue** getter steps are to return the result of running [this's default value](#).

The **defaultValue** setter steps are:

1. If [this's default value override](#) is null, then [string replace all](#) with the given value within [this](#) and return.
2. Set [this's default value override](#) to the given value.

The ***type*** getter steps are to return "output".

The ***htmlFor*** IDL attribute must reflect the ***for*** content attribute.

The [willValidate](#), [validity](#), and [validationMessage](#) IDL attributes, and the [checkValidity\(\)](#), [reportValidity\(\)](#), and [setCustomValidity\(\)](#) methods, are part of the [constraint validation API](#). The [labels](#) IDL attribute provides a list of the element's [labels](#). The [form](#) and [name](#) IDL attributes are part of the element's forms API.

A simple calculator could use [output](#) for its display of calculated results:

```
<form onsubmit="return false" oninput="o.value = a.valueAsNumber + b.valueAsNumber">
  <input id=a type=number step=any> +
  <input id=b type=number step=any> =
  <output id=o for="a b"></output>
</form>
```

In this example, an [output](#) element is used to report the results of a calculation performed by a remote server, as they come in:

```
<output id="result"></output>
<script>
  var primeSource = new WebSocket('ws://primes.example.net/');
  primeSource.onmessage = function (event) {
    document.getElementById('result').value = event.data;
  }
</script>
```

4.10.13 The ***progress*** element



[Element/progress](#)

Support in all current engines.

Firefox 6+ Safari 6+ Chrome 6+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 6+ Safari iOS 7+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 11+



[HTMLProgressElement](#)

Support in all current engines.

Firefox6+Safari6+Chrome6+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android6+Safari iOS6+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Labelable element.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content](#), but there must be no [progress](#) element descendants.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[value](#) — Current value of the element

[max](#) — Upper bound of range

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLProgressElement : HTMLElement {
  [HTMLConstructor] constructor();
  [CEReactions] attribute double value;
  [CEReactions] attribute double max;
  readonly attribute double position;
  readonly attribute NodeList labels;
};
```

The [progress](#) element [represents](#) the completion progress of a task. The progress is either indeterminate, indicating that progress is being made but that it is not clear how much more

work remains to be done before the task is complete (e.g. because the task is waiting for a remote host to respond), or the progress is a number in the range zero to a maximum, giving the fraction of work that has so far been completed.

There are two attributes that determine the current task completion represented by the element. The **value** attribute specifies how much of the task has been completed, and the **max** attribute specifies how much work the task requires in total. The units are arbitrary and not specified.

To make a determinate progress bar, add a [value](#) attribute with the current progress (either a number from 0.0 to 1.0, or, if the **max** attribute is specified, a number from 0 to the value of the **max** attribute). To make an indeterminate progress bar, remove the [value](#) attribute.

Authors are encouraged to also include the current value and the maximum value inline as text inside the element, so that the progress is made available to users of legacy user agents.

Here is a snippet of a web application that shows the progress of some automated task:

```
<section>
  <h2>Task Progress</h2>
  <p>Progress: <progress id=p max=100><span>0</span>%</progress></p>
  <script>
    var progressBar = document.getElementById('p');
    function updateProgress(newValue) {
      progressBar.value = newValue;
      progressBar.getElementsByTagName('span')[0].textContent = newValue;
    }
  </script>
</section>
```

(The `updateProgress()` method in this example would be called by some other code on the page to update the actual progress bar as the task progressed.)

The [value](#) and [max](#) attributes, when present, must have values that are [valid floating-point numbers](#). The [value](#) attribute, if present, must have a value equal to or greater than zero, and less than or equal to the value of the [max](#) attribute, if present, or 1.0, otherwise. The [max](#) attribute, if present, must have a value greater than zero.

The [progress](#) element is the wrong element to use for something that is just a gauge, as opposed to task progress. For instance, indicating disk space usage using [progress](#) would be inappropriate. Instead, the [meter](#) element is available for such use cases.

User agent requirements: If the [value](#) attribute is omitted, then the progress bar is an indeterminate progress bar. Otherwise, it is a determinate progress bar.

If the progress bar is a determinate progress bar and the element has a [max](#) attribute, the user agent must parse the [max](#) attribute's value according to the [rules for parsing floating-point](#)

[number values](#). If this does not result in an error, and if the parsed value is greater than zero, then the *maximum value* of the progress bar is that value. Otherwise, if the element has no [max](#) attribute, or if it has one but parsing it resulted in an error, or if the parsed value was less than or equal to zero, then the [maximum value](#) of the progress bar is 1.0.

If the progress bar is a determinate progress bar, user agents must parse the [value](#) attribute's value according to the [rules for parsing floating-point number values](#). If this does not result in an error and the parsed value is greater than zero, then the *value* of the progress bar is that parsed value. Otherwise, if parsing the [value](#) attribute's value resulted in an error or a number less than or equal to zero, then the [value](#) of the progress bar is zero.

If the progress bar is a determinate progress bar, then the *current value* is the [maximum value](#), if [value](#) is greater than the [maximum value](#), and [value](#) otherwise.

UA requirements for showing the progress bar: When representing a [progress](#) element to the user, the UA should indicate whether it is a determinate or indeterminate progress bar, and in the former case, should indicate the relative position of the [current value](#) relative to the [maximum value](#).

[**progress.position**](#)

For a determinate progress bar (one with known current and maximum values), returns the result of dividing the current value by the maximum value.

For an indeterminate progress bar, returns -1.

If the progress bar is an indeterminate progress bar, then the [position](#) IDL attribute must return -1. Otherwise, it must return the result of dividing the [current value](#) by the [maximum value](#).

If the progress bar is an indeterminate progress bar, then the [value](#) IDL attribute, on getting, must return 0. Otherwise, it must return the [current value](#). On setting, the given value must be converted to the [best representation of the number as a floating-point number](#) and then the [value](#) content attribute must be set to that string.

Setting the [value](#) IDL attribute to itself when the corresponding content attribute is absent would change the progress bar from an indeterminate progress bar to a determinate progress bar with no progress.

The [max](#) IDL attribute must [reflect](#) the content attribute of the same name, [limited to numbers greater than zero](#). The default value for [max](#) is 1.0.

The [labels](#) IDL attribute provides a list of the element's [label](#)s.

4.10.14 The ***meter*** element

✓MDN

Element/meter

Support in all current engines.

Firefox 16+ Safari 6+ Chrome 6+

Opera 11+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 16+ Safari iOS 10.3+ Chrome Android 18+ WebView Android No Samsung Internet 1.0+ Opera Android 11+

✓MDN

HTMLMeterElement

Support in all current engines.

Firefox 16+ Safari 6+ Chrome 6+

Opera 11+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 16+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

Categories:

[Flow content.](#)

[Phrasing content.](#)

[Labelable element.](#)

[Palpable content.](#)

Contexts in which this element can be used:

Where [phrasing content](#) is expected.

Content model:

[Phrasing content](#), but there must be no [***meter***](#) element descendants.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

value — Current value of the element

[min](#) — Lower bound of range

[max](#) — Upper bound of range

[low](#) — High limit of low range

[high](#) — Low limit of high range

[optimum](#) — Optimum value in gauge

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLMeterElement : HTMLElement {
    HTMLConstructor constructor();

    CEReactions attribute double value;
    CEReactions attribute double min;
    CEReactions attribute double max;
    CEReactions attribute double low;
    CEReactions attribute double high;
    CEReactions attribute double optimum;
    readonly attribute NodeList labels;
};
```

The [meter](#) element [represents](#) a scalar measurement within a known range, or a fractional value; for example disk usage, the relevance of a query result, or the fraction of a voting population to have selected a particular candidate.

This is also known as a gauge.

The [meter](#) element should not be used to indicate progress (as in a progress bar). For that role, HTML provides a separate [progress](#) element.

The [meter](#) element also does not represent a scalar value of arbitrary range — for example, it would be wrong to use this to report a weight, or height, unless there is a known maximum value.

There are six attributes that determine the semantics of the gauge represented by the element.

The [min](#) attribute specifies the lower bound of the range, and the [max](#) attribute specifies the upper bound. The [value](#) attribute specifies the value to have the gauge indicate as the "measured" value.

The other three attributes can be used to segment the gauge's range into "low", "medium", and "high" parts, and to indicate which part of the gauge is the "optimum" part. The `low` attribute specifies the range that is considered to be the "low" part, and the `high` attribute specifies the range that is considered to be the "high" part. The `optimum` attribute gives the position that is "optimum"; if that is higher than the "high" value then this indicates that the higher the value, the better; if it's lower than the "low" mark then it indicates that lower values are better, and naturally if it is in between then it indicates that neither high nor low values are good.

Authoring requirements: The `value` attribute must be specified. The `value`, `min`, `low`, `high`, `max`, and `optimum` attributes, when present, must have values that are [valid floating-point numbers](#).

In addition, the attributes' values are further constrained:

Let `value` be the `value` attribute's number.

If the `min` attribute is specified, then let `minimum` be that attribute's value; otherwise, let it be zero.

If the `max` attribute is specified, then let `maximum` be that attribute's value; otherwise, let it be 1.0.

The following inequalities must hold, as applicable:

- $minimum \leq value \leq maximum$
- $minimum \leq low \leq maximum$ (if `low` is specified)
- $minimum \leq high \leq maximum$ (if `high` is specified)
- $minimum \leq optimum \leq maximum$ (if `optimum` is specified)
- $low \leq high$ (if both `low` and `high` are specified)

If no minimum or maximum is specified, then the range is assumed to be 0..1, and the value thus has to be within that range.

Authors are encouraged to include a textual representation of the gauge's state in the element's contents, for users of user agents that do not support the `meter` element.

When used with `microdata`, the `meter` element's `value` attribute provides the element's machine-readable value.

The following examples show three gauges that would all be three-quarters full:

Storage space usage: `<meter value=6 max=8>6 blocks used (out of 8 total)</meter>`

Voter turnout: `<meter value=0.75></meter>`

Tickets sold: `<meter min="0" max="100" value="75"></meter>`

The following example is incorrect use of the element, because it doesn't give a range (and since the default maximum is 1, both of the gauges would end up looking maxed out):

```
<p>The grapefruit pie had a radius of <meter value=12>12cm</meter>  
and a height of <meter value=2>2cm</meter>. <!-- BAD! -->
```

Instead, one would either not include the meter element, or use the meter element with a defined range to give the dimensions in context compared to other pies:

```
<p>The grapefruit pie had a radius of 12cm and a height of  
2cm.</p>  
<dl>  
  <dt>Radius: <dd> <meter min=0 max=20 value=12>12cm</meter>  
  <dt>Height: <dd> <meter min=0 max=10 value=2>2cm</meter>  
</dl>
```

There is no explicit way to specify units in the [meter](#) element, but the units may be specified in the [title](#) attribute in free-form text.

The example above could be extended to mention the units:

```
<dl>  
  <dt>Radius: <dd> <meter min=0 max=20 value=12 title="centimeters">12cm</meter>  
  <dt>Height: <dd> <meter min=0 max=10 value=2 title="centimeters">2cm</meter>  
</dl>
```

User agent requirements: User agents must parse the [min](#), [max](#), [value](#), [low](#), [high](#), and [optimum](#) attributes using the [rules for parsing floating-point number values](#).

User agents must then use all these numbers to obtain values for six points on the gauge, as follows. (The order in which these are evaluated is important, as some of the values refer to earlier ones.)

The *minimum value*

If the [min](#) attribute is specified and a value could be parsed out of it, then the minimum value is that value. Otherwise, the minimum value is zero.

The *maximum value*

If the [max](#) attribute is specified and a value could be parsed out of it, then the candidate maximum value is that value. Otherwise, the candidate maximum value is 1.0.

If the candidate maximum value is greater than or equal to the minimum value, then the maximum value is the candidate maximum value. Otherwise, the maximum value is the same as the minimum value.

The actual value

If the [value](#) attribute is specified and a value could be parsed out of it, then that value is the candidate actual value. Otherwise, the candidate actual value is zero.

If the candidate actual value is less than the minimum value, then the actual value is the minimum value.

Otherwise, if the candidate actual value is greater than the maximum value, then the actual value is the maximum value.

Otherwise, the actual value is the candidate actual value.

The low boundary

If the [low](#) attribute is specified and a value could be parsed out of it, then the candidate low boundary is that value. Otherwise, the candidate low boundary is the same as the minimum value.

If the candidate low boundary is less than the minimum value, then the low boundary is the minimum value.

Otherwise, if the candidate low boundary is greater than the maximum value, then the low boundary is the maximum value.

Otherwise, the low boundary is the candidate low boundary.

The high boundary

If the [high](#) attribute is specified and a value could be parsed out of it, then the candidate high boundary is that value. Otherwise, the candidate high boundary is the same as the maximum value.

If the candidate high boundary is less than the low boundary, then the high boundary is the low boundary.

Otherwise, if the candidate high boundary is greater than the maximum value, then the high boundary is the maximum value.

Otherwise, the high boundary is the candidate high boundary.

The optimum point

If the [optimum](#) attribute is specified and a value could be parsed out of it, then the candidate optimum point is that value. Otherwise, the candidate optimum point is the midpoint between the minimum value and the maximum value.

If the candidate optimum point is less than the minimum value, then the optimum point is

the minimum value.

Otherwise, if the candidate optimum point is greater than the maximum value, then the optimum point is the maximum value.

Otherwise, the optimum point is the candidate optimum point.

All of which will result in the following inequalities all being true:

- minimum value \leq actual value \leq maximum value
- minimum value \leq low boundary \leq high boundary \leq maximum value
- minimum value \leq optimum point \leq maximum value

UA requirements for regions of the gauge: If the optimum point is equal to the low boundary or the high boundary, or anywhere in between them, then the region between the low and high boundaries of the gauge must be treated as the optimum region, and the low and high parts, if any, must be treated as suboptimal. Otherwise, if the optimum point is less than the low boundary, then the region between the minimum value and the low boundary must be treated as the optimum region, the region from the low boundary up to the high boundary must be treated as a suboptimal region, and the remaining region must be treated as an even less good region. Finally, if the optimum point is higher than the high boundary, then the situation is reversed; the region between the high boundary and the maximum value must be treated as the optimum region, the region from the high boundary down to the low boundary must be treated as a suboptimal region, and the remaining region must be treated as an even less good region.

UA requirements for showing the gauge: When representing a [meter](#) element to the user, the UA should indicate the relative position of the actual value to the minimum and maximum values, and the relationship between the actual value and the three regions of the gauge.

The following markup:

```
<h3>Suggested groups</h3>
<menu>
  <li><a href="?cmd=hsg" onclick="hideSuggestedGroups()">Hide suggested groups</a>
</menu>
<ul>
  <li>
    <p><a href="/group/comp.infosystems.www.authoring.stylesheets/view">comp.infosystems.www.authoring.stylesheets</a>
      <a href="/group/comp.infosystems.www.authoring.stylesheets/subscribe">join</a>
    </p>
    <p>Group description: <strong>Layout/presentation on the WWW.</strong></p>
    <p><strong><meter value="0.5">Moderate activity,</meter> Usenet, 618 subscribers</strong></p>
  </li>
  <li>
    <p><a href="/group/netscape.public.mozilla.xpininstall/view">netscape.public.mozilla.xpininstall</a>
      <a href="/group/netscape.public.mozilla.xpininstall/subscribe">join</a></p>
    </p>
    <p>Group description: <strong>Mozilla XPIInstall discussion.</strong></p>
    <p><strong><meter value="0.25">Low activity,</meter> Usenet, 22 subscribers</strong></p>
```

```

</li>
<li>
  <p><a href="/group/mozilla.dev.general/view">mozilla.dev.general</a> -
    <a href="/group/mozilla.dev.general/subscribe">join</a></p>
  <p><b><meter value="0.25">Low activity,</meter> Usenet, 66 subscribers</p>
</li>
</ul>

```

Might be rendered as follows:

Suggested groups - [Hide suggested groups](#)

[comp.infosystems.www.authoring.stylesheets](#) - [join](#)
 Group description: Layout/presentation on the WWW.
 Usenet, 618 subscribers

[netscape.public.mozilla.xpininstall](#) - [join](#)
 Group description: Mozilla XPIInstall discussion.
 Usenet, 22 subscribers

[mozilla.dev.general](#) - [join](#)
 Usenet, 66 subscribers

User agents may combine the value of the `title` attribute and the other attributes to provide context-sensitive help or inline text detailing the actual values.

For example, the following snippet:

```
<meter min=0 max=60 value=23.2 title="seconds"></meter>
```

...might cause the user agent to display a gauge with a tooltip saying "Value: 23.2 out of 60." on one line and "seconds" on a second line.

The `value` IDL attribute, on getting, must return the [actual value](#). On setting, the given value must be converted to the [best representation of the number as a floating-point number](#) and then the [value](#) content attribute must be set to that string.

The `min` IDL attribute, on getting, must return the [minimum value](#). On setting, the given value must be converted to the [best representation of the number as a floating-point number](#) and then the [min](#) content attribute must be set to that string.

The `max` IDL attribute, on getting, must return the [maximum value](#). On setting, the given value must be converted to the [best representation of the number as a floating-point number](#) and then the [max](#) content attribute must be set to that string.

The `low` IDL attribute, on getting, must return the [low boundary](#). On setting, the given value must be converted to the [best representation of the number as a floating-point number](#) and then the [low](#) content attribute must be set to that string.

The `high` IDL attribute, on getting, must return the [high boundary](#). On setting, the given value

must be converted to the [best representation of the number as a floating-point number](#) and then the [high](#) content attribute must be set to that string.

The *optimum* IDL attribute, on getting, must return the [optimum value](#). On setting, the given value must be converted to the [best representation of the number as a floating-point number](#) and then the [optimum](#) content attribute must be set to that string.

The [labels](#) IDL attribute provides a list of the element's [label](#)s.

The following example shows how a gauge could fall back to localized or pretty-printed text.

```
<p>Disk usage: <meter min=0 value=170261928 max=233257824>170 261 928 bytes used  
out of 233 257 824 bytes available</meter></p>
```

4.10.15 The **fieldset** element

✓MDN

[Element/fieldset](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

✓MDN

[HTMLFieldSetElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

[Flow content](#).

[Sectioning root](#).

[Listed](#) and [autocapitalize-inheriting form-associated element](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [flow content](#) is expected.

Content model:

Optionally a [legend](#) element, followed by [flow content](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[**disabled**](#) — Whether the descendant form controls, except any inside [legend](#), are disabled

[**form**](#) — Associates the element with a [form](#) element

[**name**](#) — Name of the element to use in the [form.elements](#) API.

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLFieldSetElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute boolean disabled;
  readonly attribute HTMLFormElement? form;
  [CEReactions] attribute DOMString name;

  readonly attribute DOMString type;

  [SameObject] readonly attribute HTMLCollection elements;
  readonly attribute boolean willValidate;
  [SameObject] readonly attribute ValidityState validity;
  readonly attribute DOMString validationMessage;
  boolean checkValidity();
  boolean reportValidity();
  undefined setCustomValidity(DOMString error);
};
```

The [fieldset](#) element [represents](#) a set of form controls (or other content) grouped together, optionally with a caption. The caption is given by the first [legend](#) element that is a child of the

[fieldset](#) element, if any. The remainder of the descendants form the group.



[Element/fieldset#attr-disabled](#)

Support in all current engines.

Firefox Yes Safari 6+ Chrome Yes

Opera 12+ Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS 6+ Chrome Android Yes WebView Android 4.4+ Samsung Internet Yes Opera Android?

The **disabled** attribute, when specified, causes all the form control descendants of the [fieldset](#) element, excluding those that are descendants of the [fieldset](#) element's first [legend](#) element child, if any, to be [disabled](#).

A [fieldset](#) element is a *disabled fieldset* if it matches any of the following conditions:

- Its [disabled](#) attribute is specified
- It is a descendant of another [fieldset](#) element whose [disabled](#) attribute is specified, and is *not* a descendant of that [fieldset](#) element's first [legend](#) element child, if any.

The [form](#) attribute is used to explicitly associate the [fieldset](#) element with its [form owner](#). The [name](#) attribute represents the element's name.

fieldset.type

Returns the string "fieldset".

fieldset.elements

Returns an [HTMLCollection](#) of the form controls in the element.

The [disabled](#) IDL attribute must [reflect](#) the content attribute of the same name.

The [type](#) IDL attribute must return the string "fieldset".

The [elements](#) IDL attribute must return an [HTMLCollection](#) rooted at the [fieldset](#) element, whose filter matches [listed elements](#).

The [willValidate](#), [validity](#), and [validationMessage](#) attributes, and the [checkValidity\(\)](#), [reportValidity\(\)](#), and [setCustomValidity\(\)](#) methods, are part of the [constraint validation API](#). The [form](#) and [name](#) IDL attributes are part of the element's forms API.

This example shows a [fieldset](#) element being used to group a set of related controls:

```
<fieldset>
  <legend>Display</legend>
  <p><label><input type=radio name=c value=0 checked> Black on White</label>
  <p><label><input type=radio name=c value=1> White on Black</label>
  <p><label><input type=checkbox name=g> Use grayscale</label>
  <p><label>Enhance contrast <input type=range name=e list=contrast min=0 max=100>
  <datalist id=contrast>
    <option label=Normal value=0>
    <option label=Maximum value=100>
  </datalist>
</fieldset>
```

The following snippet shows a fieldset with a checkbox in the legend that controls whether or not the fieldset is enabled. The contents of the fieldset consist of two required text controls and an optional year/month control.

```
<fieldset name="clubfields" disabled>
  <legend> <label>
    <input type=checkbox name=club onchange="form.clubfields.disabled = !checked">
    Use Club Card
  </label> </legend>
  <p><label>Name on card: <input name=clubname required></label></p>
  <p><label>Card number: <input name=clubnum required pattern="[-0-9]+"></label>
  <p><label>Expiry date: <input name=clubexp type=month></label></p>
</fieldset>
```

You can also nest [fieldset](#) elements. Here is an example expanding on the previous one that does so:

```
<fieldset name="clubfields" disabled>
  <legend> <label>
    <input type=checkbox name=club onchange="form.clubfields.disabled = !checked">
    Use Club Card
  </label> </legend>
  <p><label>Name on card: <input name=clubname required></label></p>
  <fieldset name="numfields">
    <legend> <label>
      <input type=radio checked name=clubtype onchange="form.numfields.disabled = !checked">
      My card has numbers on it
    </label> </legend>
    <p><label>Card number: <input name=clubnum required pattern="[-0-9]+"></label></p>
  </fieldset>
  <fieldset name="letfields" disabled>
    <legend> <label>
      <input type=radio name=clubtype onchange="form.letfields.disabled = !checked">
    </label> </legend>
```

```
    My card has letters on it
  </label> </legend>
  <p><label>Card code: <input name=clublet required pattern="[A-Za-z]+"/></label>
</fieldset>
</fieldset>
```

In this example, if the outer "Use Club Card" checkbox is not checked, everything inside the outer `fieldset`, including the two radio buttons in the legends of the two nested `fieldset`s, will be disabled. However, if the checkbox is checked, then the radio buttons will both be enabled and will let you select which of the two inner `fieldset`s is to be enabled.

This example shows a grouping of controls where the `legend` element both labels the grouping, and the nested heading element surfaces the grouping in the document outline:

```
<fieldset>
  <legend> <h2>
    How can we best reach you?
  </h2> </legend>
  <p> <label>
    <input type=radio checked name=contact_pref>
    Phone
  </label> </p>
  <p> <label>
    <input type=radio name=contact_pref>
    Text
  </label> </p>
  <p> <label>
    <input type=radio name=contact_pref>
    Email
  </label> </p>
</fieldset>
```

4.10.16 The **legend** element



[Element/legend](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+



[HTMLLegendElement](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 6+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As the [first child](#) of a [fieldset](#) element.

[Content model:](#)

[Phrasing content](#), optionally intermixed with [heading content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLLegendElement : HTMLElement {
  [HTMLConstructor] constructor();

  readonly attribute HTMLFormElement? form;
  // also has obsolete members
};
```

The [legend](#) element [represents](#) a caption for the rest of the contents of the [legend](#) element's parent [fieldset](#) element, if any.

[legend.form](#)

Returns the element's [form](#) element, if any, or null otherwise.

The *form* IDL attribute's behavior depends on whether the [legend](#) element is in a [fieldset](#)

element or not. If the [legend](#) has a [fieldset](#) element as its parent, then the [form](#) IDL attribute must return the same value as the [form](#) IDL attribute on that [fieldset](#) element. Otherwise, it must return null.

4.10.17 Form control infrastructure

4.10.17.1 A form control's value

Most form controls have a *value* and a *checkedness*. (The latter is only used by [input](#) elements.) These are used to describe how the user interacts with the control.

A control's [value](#) is its internal state. As such, it might not match the user's current input.

For instance, if a user enters the word "three" into [a numeric field](#) that expects digits, the user's input would be the string "three" but the control's [value](#) would remain unchanged. Or, if a user enters the email address " awesome@example.com" (with leading whitespace) into [an email field](#), the user's input would be the string " awesome@example.com" but the browser's UI for email fields might translate that into a [value](#) of "awesome@example.com" (without the leading whitespace).

[input](#) and [textarea](#) elements have a *dirty value flag*. This is used to track the interaction between the [value](#) and default value. If it is false, [value](#) mirrors the default value. If it is true, the default value is ignored.

To define the behavior of constraint validation in the face of the [input](#) element's [multiple](#) attribute, [input](#) elements can also have separately defined [values](#).

To define the behavior of the [maxlength](#) and [minlength](#) attributes, as well as other APIs specific to the [textarea](#) element, all form control with a [value](#) also have an algorithm for obtaining an *API value*. By default this algorithm is to simply return the control's [value](#).

The [select](#) element does not have a [value](#); the [selectedness](#) of its [option](#) elements is what is used instead.

4.10.17.2 Mutability

A form control can be designated as *mutable*.

This determines (by means of definitions and requirements in this specification that rely on whether an element is so designated) whether or not the user can modify the [value](#) or [checkedness](#) of a form control, or whether or not a control can be automatically prefilled.

4.10.17.3 Association of controls and forms

A [form-associated element](#) can have a relationship with a [form](#) element, which is called the element's *form owner*. If a [form-associated element](#) is not associated with a [form](#) element, its

[form owner](#) is said to be null.

A [form-associated element](#) has an associated *parser inserted flag*.



[Attributes#attr-form](#)

Support in all current engines.

Firefox 1+ Safari ≤ 4+ Chrome 1+

Opera ≤ 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer ≤ 6+

Firefox Android 4+ Safari iOS ≤ 3+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android ≤ 12.1+

A [form-associated element](#) is, by default, associated with its nearest ancestor [form](#) element (as described below), but, if it is [listed](#), may have a [form](#) attribute specified to override this.

This feature allows authors to work around the lack of support for nested [form](#) elements.

If a [listed form-associated element](#) has a [form](#) attribute specified, then that attribute's value must be the [ID](#) of a [form](#) element in the element's [tree](#).

The rules in this section are complicated by the fact that although conforming documents or [trees](#) will never contain nested [form](#) elements, it is quite possible (e.g., using a script that performs DOM manipulation) to generate [trees](#) that have such nested elements. They are also complicated by rules in the HTML parser that, for historical reasons, can result in a [form-associated element](#) being associated with a [form](#) element that is not its ancestor.

When a [form-associated element](#) is created, its [form owner](#) must be initialized to null (no owner).

When a [form-associated element](#) is to be associated with a form, its [form owner](#) must be set to that form.

When a [form-associated element](#) or one of its ancestors [is inserted](#), then:

1. If the [form-associated element](#)'s [parser inserted flag](#) is set, then return.
2. [Reset the form owner](#) of the [form-associated element](#).

When a [form-associated element](#) or one of its ancestors [is removed](#), then:

1. If the [form-associated element](#) has a [form owner](#) and the [form-associated element](#) and its [form owner](#) are no longer in the same [tree](#), then [reset the form owner](#) of the [form-associated element](#).

When a listed form-associated element's form attribute is set, changed, or removed, then the user agent must reset the form owner of that element.

When a listed form-associated element has a form attribute and the ID of any of the elements in the tree changes, then the user agent must reset the form owner of that form-associated element.

When a listed form-associated element has a form attribute and an element with an ID is inserted into or removed from the Document, then the user agent must reset the form owner of that form-associated element.

When the user agent is to *reset the form owner* of a form-associated element *element*, it must run the following steps:

1. Unset *element*'s parser inserted flag.
2. If all of the following conditions are true
 - *element*'s form owner is not null
 - *element* is not listed or its form content attribute is not present
 - *element*'s form owner is its nearest form element ancestor after the change to the ancestor chain

then do nothing, and return.

3. Set *element*'s form owner to null.
4. If *element* is listed, has a form content attribute, and is connected, then:
 1. If the first element in *element*'s tree, in tree order, to have an ID that is identical to *element*'s form content attribute's value, is a form element, then associate the *element* with that form element.
 5. Otherwise, if *element* has an ancestor form element, then associate *element* with the nearest such ancestor form element.

In the following non-conforming snippet

```
...
<form id="a">
  <div id="b"></div>
</form>
<script>
  document.getElementById('b').innerHTML =
    '<table><tr><td></form><form id="c"><input id="d"></table>' +
    '<input id="e">';
</script>
```

...
the [form owner](#) of "d" would be the inner nested form "c", while the [form owner](#) of "e" would be the outer form "a".

This happens as follows: First, the "e" node gets associated with "c" in the [HTML parser](#). Then, the [innerHTML](#) algorithm moves the nodes from the temporary document to the "b" element. At this point, the nodes see their ancestor chain change, and thus all the "magic" associations done by the parser are reset to normal ancestor associations.

This example is a non-conforming document, though, as it is a violation of the content models to nest [form](#) elements, and there is a [parse error](#) for the `</form>` tag.

[`element.form`](#)



[HTMLObjectElement/form](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLSelectElement/form](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the element's [form owner](#).

Returns null if there isn't one.

Listed [form-associated elements](#) except for [form-associated custom elements](#) have a [form](#) IDL attribute, which, on getting, must return the element's [form owner](#), or null if there isn't one.



[ElementInternals/form](#)

Firefox 95+Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

[Form-associated custom elements](#) don't have [form](#) IDL attribute. Instead, their [ElementInternals](#) object has a [form](#) IDL attribute. On getting, it must throw a ["NotSupportedError" DOMException](#) if the [target element](#) is not a [form-associated custom element](#). Otherwise, it must return the element's [form owner](#), or null if there isn't one.

4.10.18 Attributes common to form controls

4.10.18.1 Naming form controls: the [name](#) attribute

The [name](#) content attribute gives the name of the form control, as used in [form submission](#) and in the [form](#) element's [elements](#) object. If the attribute is specified, its value must not be the empty string or [isindex](#).

A number of user agents historically implemented special support for first-in-form text controls with the name [isindex](#), and this specification previously defined related user agent requirements for it. However, some user agents subsequently dropped that special support, and the related requirements were removed from this specification. So, to avoid problematic reinterpretations in legacy user agents, the name [isindex](#) is no longer allowed.

Other than [isindex](#), any non-empty value for [name](#) is allowed. An [ASCII case-insensitive](#) match for the name [_charset_](#) is special: if used as the name of a [Hidden](#) control with no [value](#) attribute, then during submission the [value](#) attribute is automatically given a value consisting of the submission character encoding.

The [name](#) IDL attribute must [reflect](#) the [name](#) content attribute.

DOM clobbering is a common cause of security issues. Avoid using the names of built-in form properties with the [name](#) content attribute.

In this example, the [input](#) element overrides the built-in [method](#) property:

```
let form = document.createElement("form");
let input = document.createElement("input");
form.appendChild(input);

form.method;           // => "get"
input.name = "method"; // DOM clobbering occurs here
form.method === input; // => true
```

Since the input name takes precedence over built-in form properties, the JavaScript reference

`form.method` will point to the [input](#) element named "method" instead of the built-in [method](#) property.

4.10.18.2 Submitting element directionality: the [dirname](#) attribute

The [dirname](#) attribute on a form control element enables the submission of [the directionality](#) of the element, and gives the name of the control that contains this value during [form submission](#). If such an attribute is specified, its value must not be the empty string.

In this example, a form contains a text control and a submission button:

```
<form action="addcomment.cgi" method=post>
  <p><label>Comment: <input type=text name="comment" dirname="comment.dir" req
  <p><button name="mode" type=submit value="add">Post Comment</button></p>
</form>
```

When the user submits the form, the user agent includes three fields, one called "comment", one called "comment.dir", and one called "mode"; so if the user types "Hello", the submission body might be something like:

comment=Hello&comment.dir=ltr&mode=add

If the user manually switches to a right-to-left writing direction and enters "?????", the submission body might be something like:

comment=%D9%85%D8%B1%D8%AD%D8%A8%D8%A7&comment.dir=rtl&mode=add

4.10.18.3 Limiting user input length: the [maxlength](#) attribute

A *form control* [maxlength](#) attribute, controlled by the [dirty value flag](#), declares a limit on the number of characters a user can input. The number of characters is measured using [length](#) and, in the case of [textarea](#) elements, with all newlines normalized to a single character (as opposed to CRLF pairs).

If an element has its [form control maxlength attribute](#) specified, the attribute's value must be a [valid non-negative integer](#). If the attribute is specified and applying the [rules for parsing non-negative integers](#) to its value results in a number, then that number is the element's *maximum allowed value length*. If the attribute is omitted or parsing its value results in an error, then there is no [maximum allowed value length](#).

Constraint validation: If an element has a [maximum allowed value length](#), its [dirty value flag](#) is true, its [value](#) was last changed by a user edit (as opposed to a change made by a script), and the [length](#) of the element's [API value](#) is greater than the element's [maximum allowed value length](#), then the element is [suffering from being too long](#).

User agents may prevent the user from causing the element's [API value](#) to be set to a value whose [length](#) is greater than the element's [maximum allowed value length](#).

In the case of `textarea` elements, the [API value](#) and [value](#) differ. In particular, [newline normalization](#) is applied before the [maximum allowed value length](#) is checked (whereas the [textarea wrapping transformation](#) is not applied).

4.10.18.4 Setting minimum input length requirements: the `minlength` attribute

A *form control* `minlength` attribute, controlled by the [dirty value flag](#), declares a lower bound on the number of characters a user can input. The "number of characters" is measured using [length](#) and, in the case of `textarea` elements, with all newlines normalized to a single character (as opposed to CRLF pairs).

The `minlength` attribute does not imply the `required` attribute. If the form control has no `required` attribute, then the value can still be omitted; the `minlength` attribute only kicks in once the user has entered a value at all. If the empty string is not allowed, then the `required` attribute also needs to be set.

If an element has its [form control minlength attribute](#) specified, the attribute's value must be a [valid non-negative integer](#). If the attribute is specified and applying the [rules for parsing non-negative integers](#) to its value results in a number, then that number is the element's *minimum allowed value length*. If the attribute is omitted or parsing its value results in an error, then there is no [minimum allowed value length](#).

If an element has both a [maximum allowed value length](#) and a [minimum allowed value length](#), the [minimum allowed value length](#) must be smaller than or equal to the [maximum allowed value length](#).

Constraint validation: If an element has a [minimum allowed value length](#), its [dirty value flag](#) is true, its [value](#) was last changed by a user edit (as opposed to a change made by a script), its [value](#) is not the empty string, and the [length](#) of the element's [API value](#) is less than the element's [minimum allowed value length](#), then the element is [suffering from being too short](#).

In this example, there are four text controls. The first is required, and has to be at least 5 characters long. The other three are optional, but if the user fills one in, the user has to enter at least 10 characters.

```
<form action="/events/menu.cgi" method="post">
  <p><label>Name of Event: <input required minlength=5 maxlength=50 name=event>
  <p><label>Describe what you would like for breakfast, if anything:
    <textarea name="breakfast" minlength="10"></textarea></label></p>
  <p><label>Describe what you would like for lunch, if anything:
    <textarea name="lunch" minlength="10"></textarea></label></p>
  <p><label>Describe what you would like for dinner, if anything:
    <textarea name="dinner" minlength="10"></textarea></label></p>
  <p><input type=submit value="Submit Request"></p>
</form>
```

4.10.18.5 Enabling and disabling form controls: the **disabled** attribute

The ***disabled*** content attribute is a [boolean attribute](#).

The **disabled** attribute for [**option**](#) elements and the **disabled** attribute for [**optgroup**](#) elements are defined separately.

A form control is *disabled* if any of the following conditions are met:

1. The element is a [**button**](#), [**input**](#), [**select**](#), [**textarea**](#), or [**form-associated custom element**](#), and the **disabled** attribute is specified on this element (regardless of its value).
2. The element is a descendant of a [**fieldset**](#) element whose **disabled** attribute is specified, and is *not* a descendant of that [**fieldset**](#) element's first [**legend**](#) element child, if any.

A form control that is disabled must prevent any [**click**](#) events that are [queued](#) on the [user interaction task source](#) from being dispatched on the element.

Constraint validation: If an element is disabled, it is [barred from constraint validation](#).



[HTMLButtonElement/disabled](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLSelectElement/disabled](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

The ***disabled*** IDL attribute must [reflect](#) the **disabled** content attribute.

4.10.18.6 Form submission attributes

MDN

[Element/form#Attributes_for_form_submission](#)

Support in all current engines.

Firefox 4+ Safari 10.1+ Chrome 10+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 10.3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 14+

Attributes for form submission can be specified both on [form](#) elements and on [submit buttons](#) (elements that represent buttons that submit forms, e.g. an [input](#) element whose [type](#) attribute is in the [Submit Button](#) state).

The [attributes for form submission](#) that may be specified on [form](#) elements are [action](#), [enctype](#), [method](#), [novalidate](#), and [target](#).

The corresponding [attributes for form submission](#) that may be specified on [submit buttons](#) are [formaction](#), [formenctype](#), [formmethod](#), [formnovalidate](#), and [formtarget](#). When omitted, they default to the values given on the corresponding attributes on the [form](#) element.

The [action](#) and [formaction](#) content attributes, if specified, must have a value that is a [valid non-empty URL potentially surrounded by spaces](#).

The [action](#) of an element is the value of the element's [formaction](#) attribute, if the element is a [submit button](#) and has such an attribute, or the value of its [form owner](#)'s [action](#) attribute, if it has one, or else the empty string.

The [method](#) and [formmethod](#) content attributes are [enumerated attributes](#) with the following keywords and states:

- The keyword [get](#), mapping to the state [GET](#), indicating the HTTP GET method.
- The keyword [post](#), mapping to the state [POST](#), indicating the HTTP POST method.
- The keyword [dialog](#), mapping to the state [dialog](#), indicating that submitting the [form](#) is intended to close the [dialog](#) box in which the form finds itself, if any, and otherwise not submit.

The [method](#) attribute's [invalid value default](#) and [missing value default](#) are both the [GET](#) state.

The [formmethod](#) attribute's [invalid value default](#) is the [GET](#) state. It has no [missing value](#)

default.

The *method* of an element is one of those states. If the element is a [submit button](#) and has a [formmethod](#) attribute, then the element's [method](#) is that attribute's state; otherwise, it is the [form owner](#)'s [method](#) attribute's state.

Here the [method](#) attribute is used to explicitly specify the default value, "[get](#)", so that the search query is submitted in the URL:

```
<form method="get" action="/search.cgi">
  <p><label>Search terms: <input type=search name=q></label></p>
  <p><input type=submit></p>
</form>
```

On the other hand, here the [method](#) attribute is used to specify the value "[post](#)", so that the user's message is submitted in the HTTP request's body:

```
<form method="post" action="/post-message.cgi">
  <p><label>Message: <input type=text name=m></label></p>
  <p><input type=submit value="Submit message"></p>
</form>
```

In this example, a [form](#) is used with a [dialog](#). The [method](#) attribute's "[dialog](#)" keyword is used to have the dialog automatically close when the form is submitted.

```
<dialog id="ship">
  <form method=dialog>
    <p>A ship has arrived in the harbour.</p>
    <button type=submit value="board">Board the ship</button>
    <button type=submit value="call">Call to the captain</button>
  </form>
</dialog>
<script>
  var ship = document.getElementById('ship');
  ship.showModal();
  ship.onclose = function (event) {
    if (ship.returnValue == 'board') {
      // ...
    } else {
      // ...
    }
  };
</script>
```

The [enctype](#) and [formenctype](#) content attributes are [enumerated attributes](#) with the following keywords and states:

- The "*application/x-www-form-urlencoded*" keyword and corresponding state.
- The "*multipart/form-data*" keyword and corresponding state.
- The "*text/plain*" keyword and corresponding state.

The [enctype](#) attribute's [invalid value default](#) and [missing value default](#) are both the [application/x-www-form-urlencoded](#) state.

The [formenctype](#) attribute's [invalid value default](#) is the [application/x-www-form-urlencoded](#) state. It has no [missing value default](#).

The *enctype* of an element is one of those three states. If the element is a [submit button](#) and has a [formenctype](#) attribute, then the element's [enctype](#) is that attribute's state; otherwise, it is the [form owner's enctype](#) attribute's state.

The [target](#) and [formtarget](#) content attributes, if specified, must have values that are [valid browsing context names or keywords](#).

The [novalidate](#) and [formnovalidate](#) content attributes are [boolean attributes](#). If present, they indicate that the form is not to be validated during submission.

The *no-validate state* of an element is true if the element is a [submit button](#) and the element's [formnovalidate](#) attribute is present, or if the element's [form owner's novalidate](#) attribute is present, and false otherwise.

This attribute is useful to include "save" buttons on forms that have validation constraints, to allow users to save their progress even though they haven't fully entered the data in the form. The following example shows a simple form that has two required fields. There are three buttons: one to submit the form, which requires both fields to be filled in; one to save the form so that the user can come back and fill it in later; and one to cancel the form altogether.

```
<form action="editor.cgi" method="post">
  <p><label>Name: <input required name=fn></label></p>
  <p><label>Essay: <textarea required name=essay></textarea></label></p>
  <p><input type=submit name=submit value="Submit essay"></p>
  <p><input type=submit formnovalidate name=save value="Save essay"></p>
  <p><input type=submit formnovalidate name=cancel value="Cancel"></p>
</form>
```



[HTMLFormElement/action](#)

Support in all current engines.

Firefox 1+ | Safari 3+ | Chrome 1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

[HTMLFormElement/target](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

[HTMLFormElement/method](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

[HTMLFormElement/enctype](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer6+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

[HTMLFormElement/encoding](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

The *action* IDL attribute must [reflect](#) the content attribute of the same name, except that on

getting, when the content attribute is missing or its value is the empty string, the element's `node document's URL` must be returned instead. The `target` IDL attribute must `reflect` the content attribute of the same name. The `method` and `enctype` IDL attributes must `reflect` the respective content attributes of the same name, `limited to only known values`. The `encoding` IDL attribute must `reflect` the `enctype` content attribute, `limited to only known values`. The `noValidate` IDL attribute must `reflect` the `novalidate` content attribute. The `formAction` IDL attribute must `reflect` the `formaction` content attribute, except that on getting, when the content attribute is missing or its value is the empty string, the element's `node document's URL` must be returned instead. The `formEnctype` IDL attribute must `reflect` the `formenctype` content attribute, `limited to only known values`. The `formMethod` IDL attribute must `reflect` the `formmethod` content attribute, `limited to only known values`. The `formNoValidate` IDL attribute must `reflect` the `formnovalidate` content attribute. The `formTarget` IDL attribute must `reflect` the `formtarget` content attribute.

4.10.18.7 Autofill

4.10.18.7.1 Autofilling form controls: the `autocomplete` attribute

MDN

Attributes/autocomplete

Firefox Yes Safari? Chrome 66+

Opera Yes Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android Yes Safari iOS? Chrome Android 66+ WebView Android 66+ Samsung Internet 9.0+ Opera Android Yes

User agents sometimes have features for helping users fill forms in, for example prefilling the user's address based on earlier user input. The `autocomplete` content attribute can be used to hint to the user agent how to, or indeed whether to, provide such a feature.

There are two ways this attribute is used. When wearing the *autofill expectation mantle*, the `autocomplete` attribute describes what input is expected from users. When wearing the *autofill anchor mantle*, the `autocomplete` attribute describes the meaning of the given value.

On an `input` element whose `type` attribute is in the `Hidden` state, the `autocomplete` attribute wears the *autofill anchor mantle*. In all other cases, it wears the *autofill expectation mantle*.

When wearing the *autofill expectation mantle*, the `autocomplete` attribute, if specified, must have a value that is an ordered `set of space-separated tokens` consisting of either a single token that is an `ASCII case-insensitive` match for the string "`off`", or a single token that is an `ASCII case-insensitive` match for the string "`on`", or `autofill detail tokens`.

When wearing the [autofill anchor mantle](#), the [autocomplete](#) attribute, if specified, must have a value that is an ordered [set of space-separated tokens](#) consisting of just [autofill detail tokens](#) (i.e. the "[on](#)" and "[off](#)" keywords are not allowed).

Autofill detail tokens are the following, in the order given below:

1. Optionally, a token whose first eight characters are an [ASCII case-insensitive](#) match for the string "**section-**", meaning that the field belongs to the named group.

For example, if there are two shipping addresses in the form, then they could be marked up as:

```
<fieldset>
  <legend>Ship the blue gift to...</legend>
  <p> <label> Address: <textarea name=ba autocomplete="section-blue shi
  <p> <label> City: <input name=bc autocomplete="section-blue ship
  <p> <label> Postal Code: <input name=bp autocomplete="section-blue ship
</fieldset>
<fieldset>
  <legend>Ship the red gift to...</legend>
  <p> <label> Address: <textarea name=ra autocomplete="section-red shi
  <p> <label> City: <input name=rc autocomplete="section-red shipp
  <p> <label> Postal Code: <input name=rp autocomplete="section-red shipp
</fieldset>
```

2. Optionally, a token that is an [ASCII case-insensitive](#) match for one of the following strings:

- "*shipping*", meaning the field is part of the shipping address or contact information
- "*billing*", meaning the field is part of the billing address or contact information

3. Either of the following two options:

- A token that is an [ASCII case-insensitive](#) match for one of the following [autofill field](#) names, excluding those that are [inappropriate for the control](#):

- "[name](#)"
- "[honorific-prefix](#)"
- "[given-name](#)"
- "[additional-name](#)"
- "[family-name](#)"
- "[honorific-suffix](#)"
- "[nickname](#)"
- "[username](#)"
- "[new-password](#)"

- "[current-password](#)"
- "[one-time-code](#)"
- "[organization-title](#)"
- "[organization](#)"
- "[street-address](#)"
- "[address-line1](#)"
- "[address-line2](#)"
- "[address-line3](#)"
- "[address-level4](#)"
- "[address-level3](#)"
- "[address-level2](#)"
- "[address-level1](#)"
- "[country](#)"
- "[country-name](#)"
- "[postal-code](#)"
- "[cc-name](#)"
- "[cc-given-name](#)"
- "[cc-additional-name](#)"
- "[cc-family-name](#)"
- "[cc-number](#)"
- "[cc-exp](#)"
- "[cc-exp-month](#)"
- "[cc-exp-year](#)"
- "[cc-csc](#)"
- "[cc-type](#)"
- "[transaction-currency](#)"
- "[transaction-amount](#)"
- "[language](#)"
- "[bday](#)"
- "[bday-day](#)"
- "[bday-month](#)"
- "[bday-year](#)"
- "[sex](#)"
- "[url](#)"
- "[photo](#)"

(See the table below for descriptions of these values.)

- The following, in the given order:
 1. Optionally, a token that is an [ASCII case-insensitive](#) match for one of the following strings:
 - "*home*", meaning the field is for contacting someone at their residence
 - "*work*", meaning the field is for contacting someone at their

- workplace
- "**mobile**", meaning the field is for contacting someone regardless of location
- "**fax**", meaning the field describes a fax machine's contact details
- "**pager**", meaning the field describes a pager's or beeper's contact details

2. A token that is an [ASCII case-insensitive](#) match for one of the following [autofill field](#) names, excluding those that are [inappropriate for the control](#):

- "[tel](#)"
- "[tel-country-code](#)"
- "[tel-national](#)"
- "[tel-area-code](#)"
- "[tel-local](#)"
- "[tel-local-prefix](#)"
- "[tel-local-suffix](#)"
- "[tel-extension](#)"
- "[email](#)"
- "[impp](#)"

(See the table below for descriptions of these values.)

As noted earlier, the meaning of the attribute and its keywords depends on the mantle that the attribute is wearing.

When wearing the [autofill expectation mantle](#)...

The "**off**" keyword indicates either that the control's input data is particularly sensitive (for example the activation code for a nuclear weapon); or that it is a value that will never be reused (for example a one-time-key for a bank login) and the user will therefore have to explicitly enter the data each time, instead of being able to rely on the UA to prefill the value for them; or that the document provides its own autocomplete mechanism and does not want the user agent to provide autocompletion values.

The "**on**" keyword indicates that the user agent is allowed to provide the user with autocompletion values, but does not provide any further information about what kind of data the user might be expected to enter. User agents would have to use heuristics to decide what autocompletion values to suggest.

The [autofill field](#) listed above indicate that the user agent is allowed to provide the user with autocompletion values, and specifies what kind of value is expected. The meaning of each such keyword is described in the table below.

If the [autocomplete](#) attribute is omitted, the default value corresponding to the state of the element's [form owner](#)'s [autocomplete](#) attribute is used instead (either "[on](#)" or "[off](#)").

If there is no [form owner](#), then the value "on" is used.

When wearing the [autofill anchor mantle...](#)

The [autofill field](#) listed above indicate that the value of the particular kind of value specified is that value provided for this element. The meaning of each such keyword is described in the table below.

In this example the page has explicitly specified the currency and amount of the transaction. The form requests a credit card and other billing details. The user agent could use this information to suggest a credit card that it knows has sufficient balance and that supports the relevant currency.

```
<form method=post action="step2.cgi">
<input type=hidden autocomplete=transaction-currency value="CHF">
<input type=hidden autocomplete=transaction-amount value="15.00">
<p><label>Credit card number: <input type=text inputmode=numeric autocomplete=cc-number>
<p><label>Expiry Date: <input type=month autocomplete=cc-exp></label>
<p><input type=submit value="Continue...">
</form>
```

The *autofill field* keywords relate to each other as described in the table below. Each field name listed on a row of this table corresponds to the meaning given in the cell for that row in the column labeled "Meaning". Some fields correspond to subparts of other fields; for example, a credit card expiry date can be expressed as one field giving both the month and year of expiry ("[cc-exp](#)"), or as two fields, one giving the month ("[cc-exp-month](#)") and one the year ("[cc-exp-year](#)"). In such cases, the names of the broader fields cover multiple rows, in which the narrower fields are defined.

Generally, authors are encouraged to use the broader fields rather than the narrower fields, as the narrower fields tend to expose Western biases. For example, while it is common in some Western cultures to have a given name and a family name, in that order (and thus often referred to as a *first name* and a *surname*), many cultures put the family name first and the given name second, and many others simply have one name (a *mononym*). Having a single field is therefore more flexible.

Some fields are only appropriate for certain form controls. An [autofill field](#) name is *inappropriate for a control* if the control does not belong to the group listed for that [autofill field](#) in the fifth column of the first row describing that [autofill field](#) in the table below. What controls fall into each group is described below the table.

Field name	Meaning	Canonical Format	Canonical Format Example	Control group
"name"	Full name	Free-form text, no newlines	Sir Timothy John Berners-Lee, OM, KBE, FRS, FREng, FRSA	Text

Field name	Meaning	Canonical Format	Canonical Format Example	Control group
" <i>honorific-prefix</i> "	Prefix or title (e.g. "Mr.", "Ms.", "Dr.", "Mlle")	Free-form text, no newlines	Sir	Text
" <i>given-name</i> "	Given name (in some Western cultures, also known as the <i>first name</i>)	Free-form text, no newlines	Timothy	Text
" <i>additional-name</i> "	Additional names (in some Western cultures, also known as <i>middle names</i> , forenames other than the first name)	Free-form text, no newlines	John	Text
" <i>family-name</i> "	Family name (in some Western cultures, also known as the <i>last name</i> or <i>surname</i>)	Free-form text, no newlines	Berners-Lee	Text
" <i>honorific-suffix</i> "	Suffix (e.g. "Jr.", "B.Sc.", "MBASW", "II")	Free-form text, no newlines	OM, KBE, FRS, FREng, FRSA	Text
" <i>nickname</i> "	Nickname, screen name, handle: a typically short name used instead of the full name	Free-form text, no newlines	Tim	Text
" <i>organization-title</i> "	Job title (e.g. "Software Engineer", "Senior Vice President", "Deputy Managing Director")	Free-form text, no newlines	Professor	Text
" <i>username</i> "	A username	Free-form text, no newlines	timbl	Username
" <i>new-password</i> "	A new password (e.g. when creating an account or changing a password)	Free-form text, no newlines	GUMFXbadyrS3	Password
" <i>current-password</i> "	The current password for the account identified by the username field (e.g. when logging in)	Free-form text, no newlines	qwerty	Password
" <i>one-time-code</i> "	One-time code used for verifying user identity	Free-form text, no newlines	123456	Password
" <i>organization</i> "	Company name corresponding to the person, address, or contact information in the other fields associated with this field	Free-form text, no newlines	World Wide Web Consortium	Text
" <i>street-address</i> "	Street address (multiple lines, newlines preserved)	Free-form text	32 Vassar Street MIT Room 32-G524	Multiline
" <i>address-line1</i> "	Street address (one line per field)	Free-form text, no newlines	32 Vassar Street	Text
" <i>address-</i>		Free-form	MIT Room 32-G524	Text

Field name	Meaning	Canonical Format	Canonical Format Example	Control group
" <i>line2</i> "		text, no newlines		
" <i>address-line3</i> "		Free-form text, no newlines		Text
" <i>address-level4</i> "	The most fine-grained administrative level , in addresses with four administrative levels	Free-form text, no newlines		Text
" <i>address-level3</i> "	The third administrative level , in addresses with three or more administrative levels	Free-form text, no newlines		Text
" <i>address-level2</i> "	The second administrative level , in addresses with two or more administrative levels; in the countries with two administrative levels, this would typically be the city, town, village, or other locality within which the relevant street address is found	Free-form text, no newlines	Cambridge	Text
" <i>address-level1</i> "	The broadest administrative level in the address, i.e. the province within which the locality is found; for example, in the US, this would be the state; in Switzerland it would be the canton; in the UK, the post town	Free-form text, no newlines	MA	Text
" <i>country</i> "	Country code	Valid ISO 3166-1-alpha-2 country code [ISO3166]	US	Text
" <i>country-name</i> "	Country name	Free-form text, no newlines; derived from country in some cases	US	Text
" <i>postal-code</i> "	Postal code, post code, ZIP code, CEDEX code (if CEDEX, append "CEDEX", and the <i>arrondissement</i> , if relevant, to the address-level2 field)	Free-form text, no newlines	02139	Text
" <i>cc-name</i> "	Full name as given on the payment instrument	Free-form text, no newlines	Tim Berners-Lee	Text
" <i>cc-given</i> "	Given name as given on the payment instrument (in some Western cultures, text, no	Free-form text, no newlines	Tim	Text

Field name	Meaning	Canonical Format	Canonical Format Example	Control group
"name"	also known as the <i>first name</i>)	newlines		
"cc-additional-name"	Additional names given on the payment instrument (in some Western cultures, also known as <i>middle names</i> , forenames other than the first name)	Free-form text, no newlines		Text
"cc-family-name"	Family name given on the payment instrument (in some Western cultures, also known as the <i>last name</i> or <i>surname</i>)	Free-form text, no newlines	Berners-Lee	Text
"cc-number"	Code identifying the payment instrument (e.g. the credit card number)	ASCII digits	4114360123456785	Text
"cc-exp"	Expiration date of the payment instrument	Valid month string Valid integer	2014-12	Month
"cc-exp-month"	Month component of the expiration date of the payment instrument	in the range 1..12	12	Numeric
"cc-exp-year"	Year component of the expiration date of the payment instrument	Valid integer greater than zero	2014	Numeric
"cc-csc"	Security code for the payment instrument (also known as the card security code (CSC), card validation code (CVC), card verification value (CVV), signature panel code (SPC), credit card ID (CCID), etc.)	ASCII digits	419	Text
"cc-type"	Type of payment instrument	Free-form text, no newlines	Visa	Text
"transaction-currency"	The currency that the user would prefer the transaction to use	ISO 4217 currency code [ISO4217]	GBP	Text
"transaction-amount"	The amount that the user would like for the transaction (e.g. when entering a bid or sale price)	Valid floating-point number	401.00	Numeric
"language"	Preferred language	Valid BCP 47 language tag [BCP47]	en	Text
"bday"	Birthday	Valid date string	1955-06-08	Date
"bday-day"	Day component of birthday	Valid integer in the range 1..31	8	Numeric

Field name	Meaning	Canonical Format	Canonical Format Example	Control group
<i>"bdy-month"</i>	Month component of birthday	Valid integer in the range 1..12	6	Numeric
<i>"bdy-year"</i>	Year component of birthday	Valid integer greater than zero	1955	Numeric
<i>"sex"</i>	Gender identity (e.g. Female, Fa'afafine)	Free-form text, no newlines	Male	Text
<i>"url"</i>	Home page or other web page corresponding to the company, person, address, or contact information in the other fields associated with this field	Valid URL string	https://www.w3.org/ People/Berners-Lee/ URL	
<i>"photo"</i>	Photograph, icon, or other image corresponding to the company, person, address, or contact information in the other fields associated with this field	Valid URL string	https://www.w3.org/ Press/Stock/ Berners-Lee/ URL 2001-europaeum- eighth.jpg	
<i>"tel"</i>	Full telephone number, including country code	ASCII digits and U+0020 SPACE characters, prefixed by a U+002B PLUS SIGN character (+)	+1 617 253 5702	Tel
<i>"tel-country-code"</i>	Country code component of the telephone number	ASCII digits prefixed by a U+002B PLUS SIGN character (+)	+1	Text
<i>"tel-national"</i>	Telephone number without the country code component, with a country-internal prefix applied if applicable	ASCII digits and U+0020 SPACE characters	617 253 5702	Text
<i>"tel-area-code"</i>	Area code component of the telephone number, with a country-internal prefix applied if applicable	ASCII digits	617	Text
<i>"tel-local"</i>	Telephone number without the country code and area code components	ASCII digits	2535702	Text
<i>"tel-local-prefix"</i>	First part of the component of the telephone number that follows the	ASCII digits	253	Text

Field name	Meaning	Canonical Format	Canonical Format Example	Control group
"tel-local-suffix"	area code, when that component is split into two components Second part of the component of the telephone number that follows the area code, when that component is split into two components	ASCII digits	5702	Text
"tel-extension"	Telephone number internal extension code	ASCII digits	1000	Text
"email"	Email address	Valid email address	timbl@w3.org	Username
"impp"	URL representing an instant messaging protocol endpoint (for example, "aim:goim?screenname=example" or "xmpp:fred@example.net")	Valid URL string	irc://example.org/timbl,isuser	URL

The groups correspond to controls as follows:

Text

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[textarea](#) elements

[select](#) elements

Multiline

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[textarea](#) elements

[select](#) elements

Password

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[input](#) elements with a [type](#) attribute in the [Password](#) state

[textarea](#) elements

[select](#) elements

URL

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[input](#) elements with a [type](#) attribute in the [URL](#) state

[textarea](#) elements

[select](#) elements

Username

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[input](#) elements with a [type](#) attribute in the [Email](#) state

[textarea](#) elements

[select](#) elements

Tel

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[input](#) elements with a [type](#) attribute in the [Telephone](#) state

[textarea](#) elements

[select](#) elements

Numeric

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[input](#) elements with a [type](#) attribute in the [Number](#) state

[textarea](#) elements

[select](#) elements

Month

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[input](#) elements with a [type](#) attribute in the [Month](#) state

[textarea](#) elements

[select](#) elements

Date

[input](#) elements with a [type](#) attribute in the [Hidden](#) state

[input](#) elements with a [type](#) attribute in the [Text](#) state

[input](#) elements with a [type](#) attribute in the [Search](#) state

[input](#) elements with a [type](#) attribute in the [Date](#) state

[textarea](#) elements

[select](#) elements

Address levels: The "[address-level1](#)" – "[address-level4](#)" fields are used to describe the locality of the street address. Different locales have different numbers of levels. For example, the US uses two levels (state and town), the UK uses one or two depending on the address (the post town, and in some cases the locality), and China can use three (province, city, district). The "[address-level1](#)" field represents the widest administrative division. Different locales order the fields in different ways; for example, in the US the town (level 2) precedes the state (level 1); while in Japan the prefecture (level 1) precedes the city (level 2) which precedes the district (level 3). Authors are encouraged to provide forms that are presented in a way that matches the country's conventions (hiding, showing, and rearranging fields accordingly as the user changes the country).

4.10.18.7.2 Processing model

Each [input](#) element to which the [autocomplete](#) attribute [applies](#), each [select](#) element, and each [textarea](#) element, has an *autofill hint set*, an *autofill scope*, an *autofill field name*, and an *IDL-exposed autofill value*.

The [autofill field name](#) specifies the specific kind of data expected in the field, e.g. "[street-](#)

[address](#)" or "[cc-exp](#)".

The [autofill hint set](#) identifies what address or contact information type the user agent is to look at, e.g. "[shipping fax](#)" or "[billing](#)".

The [autofill scope](#) identifies the group of fields whose information concerns the same subject, and consists of the [autofill hint set](#) with, if applicable, the "[section-*](#)" prefix, e.g. "[billing](#)", "[section-parent shipping](#)", or "[section-child shipping home](#)".

These values are defined as the result of running the following algorithm:

1. If the element has no [autocomplete](#) attribute, then jump to the step labeled *default*.
2. Let *tokens* be the result of [splitting the attribute's value on ASCII whitespace](#).
3. If *tokens* is empty, then jump to the step labeled *default*.
4. Let *index* be the index of the last token in *tokens*.
5. If the *index*th token in *tokens* is not an [ASCII case-insensitive](#) match for one of the tokens given in the first column of the following table, or if the number of tokens in *tokens* is greater than the maximum number given in the cell in the second column of that token's row, then jump to the step labeled *default*. Otherwise, let *field* be the string given in the cell of the first column of the matching row, and let *category* be the value of the cell in the third column of that same row.

Token	Maximum number of tokens	Category
"off"	1	Off
"on"	1	Automatic
"name"	3	Normal
"honorific-prefix"	3	Normal
"given-name"	3	Normal
"additional-name"	3	Normal
"family-name"	3	Normal
"honorific-suffix"	3	Normal
"nickname"	3	Normal
"organization-title"	3	Normal
"username"	3	Normal
"new-password"	3	Normal
"current-password"	3	Normal
"one-time-code"	3	Normal
"organization"	3	Normal
"street-address"	3	Normal
"address-line1"	3	Normal

Token	Maximum number of tokens	Category
" address-line2 "	3	Normal
" address-line3 "	3	Normal
" address-level4 "	3	Normal
" address-level3 "	3	Normal
" address-level2 "	3	Normal
" address-level1 "	3	Normal
" country "	3	Normal
" country-name "	3	Normal
" postal-code "	3	Normal
" cc-name "	3	Normal
" cc-given-name "	3	Normal
" cc-additional-name "	3	Normal
" cc-family-name "	3	Normal
" cc-number "	3	Normal
" cc-exp "	3	Normal
" cc-exp-month "	3	Normal
" cc-exp-year "	3	Normal
" cc-csc "	3	Normal
" cc-type "	3	Normal
" transaction-currency "	3	Normal
" transaction-amount "	3	Normal
" language "	3	Normal
" bday "	3	Normal
" bday-day "	3	Normal
" bday-month "	3	Normal
" bday-year "	3	Normal
" sex "	3	Normal
" url "	3	Normal
" photo "	3	Normal
" tel "	4	Contact
" tel-country-code "	4	Contact
" tel-national "	4	Contact
" tel-area-code "	4	Contact
" tel-local "	4	Contact
" tel-local-prefix "	4	Contact
" tel-local-suffix "	4	Contact
" tel-extension "	4	Contact
" email "	4	Contact
" impp "	4	Contact

6. If *category* is Off or Automatic but the element's [autocomplete](#) attribute is wearing the [autofill anchor mantle](#), then jump to the step labeled *default*.
7. If *category* is Off, let the element's [autofill field name](#) be the string "**off**", let its [autofill hint set](#) be empty, and let its [IDL-exposed autofill value](#) be the string "**off**". Then, return.
8. If *category* is Automatic, let the element's [autofill field name](#) be the string "**on**", let its [autofill hint set](#) be empty, and let its [IDL-exposed autofill value](#) be the string "**on**". Then, return.
9. Let *scope tokens* be an empty list.
10. Let *hint tokens* be an empty set.
11. Let *IDL value* have the same value as *field*.
12. If the *index*th token in *tokens* is the first entry, then skip to the step labeled *done*.
13. Decrement *index* by one.
14. If *category* is Contact and the *index*th token in *tokens* is an [ASCII case-insensitive](#) match for one of the strings in the following list, then run the substeps that follow:
 - "[home](#)"
 - "[work](#)"
 - "[mobile](#)"
 - "[fax](#)"
 - "[pager](#)"
 The substeps are:
 1. Let *contact* be the matching string from the list above.
 2. Insert *contact* at the start of *scope tokens*.
 3. Add *contact* to *hint tokens*.
 4. Let *IDL value* be the concatenation of *contact*, a U+0020 SPACE character, and the previous value of *IDL value* (which at this point will always be *field*).
 5. If the *index*th entry in *tokens* is the first entry, then skip to the step labeled *done*.
 6. Decrement *index* by one.
15. If the *index*th token in *tokens* is an [ASCII case-insensitive](#) match for one of the strings in the following list, then run the substeps that follow:

- "[shipping](#)"
- "[billing](#)"

The substeps are:

1. Let *mode* be the matching string from the list above.
2. Insert *mode* at the start of *scope tokens*.
3. Add *mode* to *hint tokens*.
4. Let *IDL value* be the concatenation of *mode*, a U+0020 SPACE character, and the previous value of *IDL value* (which at this point will either be *field* or the concatenation of *contact*, a space, and *field*).
5. If the *indexth* entry in *tokens* is the first entry, then skip to the step labeled *done*.
6. Decrement *index* by one.
16. If the *indexth* entry in *tokens* is not the first entry, then jump to the step labeled *default*.
17. If the first eight characters of the *indexth* token in *tokens* are not an [ASCII case-insensitive](#) match for the string "[section-](#)", then jump to the step labeled *default*.
18. Let *section* be the *indexth* token in *tokens*, [converted to ASCII lowercase](#).
19. Insert *section* at the start of *scope tokens*.
20. Let *IDL value* be the concatenation of *section*, a U+0020 SPACE character, and the previous value of *IDL value*.
21. *Done*: Let the element's [autofill hint set](#) be *hint tokens*.
22. Let the element's [autofill scope](#) be *scope tokens*.
23. Let the element's [autofill field name](#) be *field*.
24. Let the element's [IDL-exposed autofill value](#) be *IDL value*.
25. Return.
26. *Default*: Let the element's [IDL-exposed autofill value](#) be the empty string, and its [autofill hint set](#) and [autofill scope](#) be empty.
27. If the element's [autocomplete](#) attribute is wearing the [autofill anchor mantle](#), then let the element's [autofill field name](#) be the empty string and return.

28. Let *form* be the element's [form owner](#), if any, or null otherwise.
 29. If *form* is not null and *form*'s **autocomplete** attribute is in the [off](#) state, then let the element's [autofill field name](#) be "[off](#)".
Otherwise, let the element's [autofill field name](#) be "[on](#)".
-

For the purposes of autofill, a *control's data* depends on the kind of control:

An **input** element with its **type** attribute in the [Email](#) state and with the **multiple** attribute specified

The element's [values](#).

Any other **input** element

A **textarea** element

The element's [value](#).

A **select** element with its **multiple** attribute specified

The **option** elements in the **select** element's [list of options](#) that have their [selectedness](#) set to true.

Any other **select** element

The **option** element in the **select** element's [list of options](#) that has its [selectedness](#) set to true.

How to process the [autofill hint set](#), [autofill scope](#), and [autofill field name](#) depends on the mantle that the **autocomplete** attribute is wearing.

When wearing the [autofill expectation mantle](#)...

When an element's [autofill field name](#) is "[off](#)", the user agent should not remember the [control's data](#), and should not offer past values to the user.

In addition, when an element's [autofill field name](#) is "[off](#)", [values are reset](#) when [traversing the history](#).

Banks frequently do not want UAs to prefill login information:

```
<p><label>Account: <input type="text" name="ac" autocomplete="off"></label>
<p><label>PIN: <input type="password" name="pin" autocomplete="off"></label>
```

When an element's [autofill field name](#) is *not* "[off](#)", the user agent may store the [control's data](#), and may offer previously stored values to the user.

For example, suppose a user visits a page with this control:

```
<select name="country">
  <option>Afghanistan
  <option>Albania
  <option>Algeria
  <option>Andorra
  <option>Angola
  <option>Antigua and Barbuda
  <option>Argentina
  <option>Armenia
  <!-- ... -->
  <option>Yemen
  <option>Zambia
  <option>Zimbabwe
</select>
```

This might render as follows:



Suppose that on the first visit to this page, the user selects "Zambia". On the second visit, the user agent could duplicate the entry for Zambia at the top of the list, so that the interface instead looks like this:



When the [autofill field name](#) is "[on](#)", the user agent should attempt to use heuristics to determine the most appropriate values to offer the user, e.g. based on the element's [name](#) value, the position of the element in its [tree](#), what other fields exist in the form, and so forth.

When the [autofill field name](#) is one of the names of the [autofill fields](#) described above, the

user agent should provide suggestions that match the meaning of the field name as given in the table earlier in this section. The [autofill hint set](#) should be used to select amongst multiple possible suggestions.

For example, if a user once entered one address into fields that used the "[shipping](#)" keyword, and another address into fields that used the "[billing](#)" keyword, then in subsequent forms only the first address would be suggested for form controls whose [autofill hint set](#) contains the keyword "[shipping](#)". Both addresses might be suggested, however, for address-related form controls whose [autofill hint set](#) does not contain either keyword.

When wearing the [autofill anchor mantle](#)...

When the [autofill field name](#) is not the empty string, then the user agent must act as if the user had specified the [control's data](#) for the given [autofill hint set](#), [autofill scope](#), and [autofill field name](#) combination.

When the user agent *autofills form controls*, elements with the same [form owner](#) and the same [autofill scope](#) must use data relating to the same person, address, payment instrument, and contact details. When a user agent autofills "[country](#)" and "[country-name](#)" fields with the same [form owner](#) and [autofill scope](#), and the user agent has a value for the [country](#) field(s), then the [country-name](#) field(s) must be filled using a human-readable name for the same country. When a user agent fills in multiple fields at once, all fields with the same [autofill field name](#), [form owner](#) and [autofill scope](#) must be filled with the same value.

Suppose a user agent knows of two phone numbers, +1 555 123 1234 and +1 555 666 7777. It would not be conforming for the user agent to fill a field with **autocomplete="shipping tel-local-prefix"** with the value "123" and another field in the same form with **autocomplete="shipping tel-local-suffix"** with the value "7777". The only valid prefilled values given the aforementioned information would be "123" and "1234", or "666" and "7777", respectively.

Similarly, if a form for some reason contained both a "[cc-exp](#)" field and a "[cc-exp-month](#)" field, and the user agent prefilled the form, then the month component of the former would have to match the latter.

This requirement interacts with the [autofill anchor mantle](#) also. Consider the following markup snippet:

```
<form>
  <input type=hidden autocomplete="nickname" value="TreePlate">
  <input type=text autocomplete="nickname">
</form>
```

The only value that a conforming user agent could suggest in the text control is "TreePlate", the value given by the hidden [input](#) element.

The "**section-***" tokens in the [autofill scope](#) are opaque; user agents must not attempt to

derive meaning from the precise values of these tokens.

For example, it would not be conforming if the user agent decided that it should offer the address it knows to be the user's daughter's address for "**section-child**" and the addresses it knows to be the user's spouses' addresses for "**section-spouse**".

The autocomplete mechanism must be implemented by the user agent acting as if the user had modified the [control's data](#), and must be done at a time where the element is [mutable](#) (e.g. just after the element has been inserted into the document, or when the user agent [stops parsing](#)). User agents must only prefill controls using values that the user could have entered.

For example, if a [select](#) element only has [option](#) elements with values "Steve" and "Rebecca", "Jay", and "Bob", and has an [autofill field name "given-name"](#), but the user agent's only idea for what to prefill the field with is "Evan", then the user agent cannot prefill the field. It would not be conforming to somehow set the [select](#) element to the value "Evan", since the user could not have done so themselves.

A user agent prefilling a form control must not discriminate between form controls that are [in a document tree](#) and those that are [connected](#); that is, it is not conforming to make the decision on whether or not to autofill based on whether the element's [root](#) is a [shadow root](#) versus a [Document](#).

A user agent prefilling a form control's [value](#) must not cause that control to [suffer from a type mismatch](#), [suffer from being too long](#), [suffer from being too short](#), [suffer from an underflow](#), [suffer from an overflow](#), or [suffer from a step mismatch](#). A user agent prefilling a form control's [value](#) must not cause that control to [suffer from a pattern mismatch](#) either. Where possible given the control's constraints, user agents must use the format given as canonical in the aforementioned table. Where it's not possible for the canonical format to be used, user agents should use heuristics to attempt to convert values so that they can be used.

For example, if the user agent knows that the user's middle name is "Ines", and attempts to prefill a form control that looks like this:

```
<input name=middle-initial maxlength=1 autocomplete="additional-name">
```

...then the user agent could convert "Ines" to "I" and prefill it that way.

A more elaborate example would be with month values. If the user agent knows that the user's birthday is the 27th of July 2012, then it might try to prefill all of the following controls with slightly different values, all driven from this information:

```
<input name=b type=month autocomplete="bday">
```

2012-07

The day dropped since the Month s only acc a month

```
<select name=c autocomplete="bday">
  <option>Jan
  <option>Feb
  ...
  <option>Jul
  <option>Aug
  ...
</select>
```

July

year
combination
(Note that
this example
is non-conformant
because
autocomplete is
name both
is not
allowed
the Mon
state.)
The user
agent picks
the month
from the
listed
options,
either by
noticing
there are
twelve
options and
picking the
7th, or by
recognizing
that one of
the strings
(three characters)
"Jul"
followed
a newline
and a space
is a close
match for
the name
the month
(July) in
of the user
agent's
supported
languages
or through
some other
similar

```

<input name=a type=number min=1 max=12 autocomplete="bday-month">7
mechanism
User agent converts "July" to month number the range 1..12, likely field.

<input name=a type=number min=0 max=11 autocomplete="bday-month">6
User agent converts "July" to month number the range 0..11, likely field.

<input name=a type=number min=1 max=11 autocomplete="bday-month">
User agent doesn't fill the field since it can't make a good guess as to what the form expects.

```

A user agent may allow the user to override an element's [autofill field name](#), e.g. to change it from "[off](#)" to "[on](#)" to allow values to be remembered and prefilled despite the page author's objections, or to always "[off](#)", never remembering values.

More specifically, user agents may in particular consider replacing the [autofill field name](#) of form controls that match the description given in the first column of the following table, when their [autofill field name](#) is either "[on](#)" or "[off](#)", with the value given in the second cell of that row. If this table is used, the replacements must be done in [tree order](#), since all but the first row references the [autofill field name](#) of earlier elements. When the descriptions below refer to form controls being preceded or followed by others, they mean in the list of [listed elements](#) that share the same [form owner](#).

Form control

New [autofill field name](#)

- an [input](#) element whose [type](#) attribute is in the [Text](#) state that is followed by an "[username](#)" [input](#) element whose [type](#) attribute is in the [Password](#) state
- an [input](#) element whose [type](#) attribute is in the [Password](#) state that is preceded by an [input](#) element whose [autofill field name](#) is "[username](#)" [password](#)"
- an [input](#) element whose [type](#) attribute is in the [Password](#) state that is preceded by "[new-](#)"

Form control	New autofill field name password
by an input element whose autofill field name is " current-password " an input element whose type attribute is in the Password state that is preceded by an input element whose autofill field name is " new-password "	new-password

The **autocomplete** IDL attribute, on getting, must return the element's [IDL-exposed autofill value](#), and on setting, must [reflect](#) the content attribute of the same name.

4.10.19 APIs for the text control selections

The [input](#) and [textarea](#) elements define several attributes and methods for handling their selection. Their shared algorithms are defined here.

[element.select\(\)](#)

Selects everything in the text control.

[element.selectionStart \[= value \]](#)

Returns the offset to the start of the selection.

Can be set, to change the start of the selection.

[element.selectionEnd \[= value \]](#)

Returns the offset to the end of the selection.

Can be set, to change the end of the selection.

[element.selectionDirection \[= value \]](#)

Returns the current direction of the selection.

Can be set, to change the direction of the selection.

The possible values are "forward", "backward", and "none".

[element.setSelectionRange\(start, end \[, direction\]\)](#)

✓MDN

[HTMLInputElement/setSelectionRange](#)

Support in all current engines.

Firefox 1+ | Safari 3+ | Chrome 1+

Opera8+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Changes the selection to cover the given substring in the given direction. If the direction is omitted, it will be reset to be the platform default (none or forward).

`element.setRangeText(replacement [, start, end [, selectionMode]])`

✓MDN

[HTMLInputElement/setRangeText](#)

Support in all current engines.

Firefox27+Safari7+Chrome24+

Opera15+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android27+Safari iOS7+Chrome Android25+WebView Android37+Samsung Internet1.5+Opera Android14+

Replaces a range of text with the new text. If the `start` and `end` arguments are not provided, the range is assumed to be the selection.

The final argument determines how the selection will be set after the text has been replaced. The possible values are:

"select"

Selects the newly inserted text.

"start"

Moves the selection to just before the inserted text.

"end"

Moves the selection to just after the selected text.

"preserve"

Attempts to preserve the selection. This is the default.

All `input` elements to which these APIs apply, and all `textarea` elements, have either a *selection* or a *text entry cursor position* at all times (even for elements that are not being rendered), measured in offsets into the `code units` of the control's relevant value. The initial state must consist of a text entry cursor at the beginning of the control.

For `input` elements, these APIs must operate on the element's value. For `textarea` elements, these APIs must operate on the element's API value. In the below algorithms, we call the value string being operated on the *relevant value*.

The use of [API value](#) instead of [raw value](#) for [textarea](#) elements means that U+000D (CR) characters are normalized away. For example,

```
<textarea id="demo"></textarea>
<script>
  demo.value = "A\r\nB";
  demo.setRangeText("replaced", 0, 2);
  assert(demo.value === "replacedB");
</script>
```

If we had operated on the [raw value](#) of "A\r\nB", then we would have replaced the characters "A\r", ending up with a result of "replaced\nB". But since we used the [API value](#) of "A\nB", we replaced the characters "A\n", giving "replacedB".

Characters with no visible rendering, such as U+200D ZERO WIDTH JOINER, still count as characters. Thus, for instance, the selection can include just an invisible character, and the text insertion cursor can be placed to one side or another of such a character.

Whenever the [relevant value](#) changes for an element to which these APIs apply, run these steps:

1. If the element has a [selection](#):
 1. If the start of the selection is now past the end of the [relevant value](#), set it to the end of the [relevant value](#).
 2. If the end of the selection is now past the end of the [relevant value](#), set it to the end of the [relevant value](#).
 3. If the user agent does not support empty selection, and both the start and end of the selection are now pointing to the end of the [relevant value](#), then instead set the element's [text entry cursor position](#) to the end of the [relevant value](#), removing any selection.
2. Otherwise, the element must have a [text entry cursor position](#) position. If it is now past the end of the [relevant value](#), set it to the end of the [relevant value](#).

In some cases where the [relevant value](#) changes, other parts of the specification will also modify the [text entry cursor position](#), beyond just the clamping steps above. For example, see the [value](#) setter for [textarea](#).

Where possible, user interface features for changing the [text selection](#) in [input](#) and [textarea](#) elements must be implemented using the [set the selection range](#) algorithm so that, e.g., all the same events fire.

The [selections](#) of [input](#) and [textarea](#) elements have a *selection direction*, which is either "forward", "backward", or "none". The exact meaning of the selection direction depends on the platform. This direction is set when the user manipulates the selection. The initial [selection](#)

[direction](#) must be "none" if the platform supports that direction, or "forward" otherwise.

To set the *selection direction* of an element to a given direction, update the element's [selection direction](#) to the given direction, unless the direction is "none" and the platform does not support that direction; in that case, update the element's [selection direction](#) to "forward".

On Windows, the direction indicates the position of the caret relative to the selection: a "forward" selection has the caret at the end of the selection and a "backward" selection has the caret at the start of the selection. Windows has no "none" direction.

On Mac, the direction indicates which end of the selection is affected when the user adjusts the size of the selection using the arrow keys with the Shift modifier: the "forward" direction means the end of the selection is modified, and the "backward" direction means the start of the selection is modified. The "none" direction is the default on Mac, it indicates that no particular direction has yet been selected. The user sets the direction implicitly when first adjusting the selection, based on which directional arrow key was used.



[HTMLInputElement/select](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[HTMLInputElement/select](#)

The `select()` method, when invoked, must run the following steps:

1. If this element is an [input](#) element, and either [select\(\) does not apply](#) to this element or the corresponding control has no selectable text, return.

For instance, in a user agent where `<input type="color">` is rendered as a color well with a picker, as opposed to a text control accepting a hexadecimal color code, there would be no selectable text, and thus calls to the method are ignored.

2. [Set the selection range](#) with 0 and infinity.

The `selectionStart` attribute's getter must run the following steps:

1. If this element is an [input](#) element, and [selectionStart does not apply](#) to this element, return null.

2. If there is no [selection](#), return the [code unit](#) offset within the [relevant value](#) to the character that immediately follows the [text entry cursor](#).
3. Return the [code unit](#) offset within the [relevant value](#) to the character that immediately follows the start of the [selection](#).

The [selectionStart](#) attribute's setter must run the following steps:

1. If this element is an [input](#) element, and [selectionStart does not apply](#) to this element, throw an ["InvalidStateError" DOMException](#).
2. Let *end* be the value of this element's [selectionEnd](#) attribute.
3. If *end* is less than the given value, set *end* to the given value.
4. [Set the selection range](#) with the given value, *end*, and the value of this element's [selectionDirection](#) attribute.

The [selectionEnd](#) attribute's getter must run the following steps:

1. If this element is an [input](#) element, and [selectionEnd does not apply](#) to this element, return null.
2. If there is no [selection](#), return the [code unit](#) offset within the [relevant value](#) to the character that immediately follows the [text entry cursor](#).
3. Return the [code unit](#) offset within the [relevant value](#) to the character that immediately follows the end of the [selection](#).

The [selectionEnd](#) attribute's setter must run the following steps:

1. If this element is an [input](#) element, and [selectionEnd does not apply](#) to this element, throw an ["InvalidStateError" DOMException](#).
2. [Set the selection range](#) with the value of this element's [selectionStart](#) attribute, the given value, and the value of this element's [selectionDirection](#) attribute.

The [selectionDirection](#) attribute's getter must run the following steps:

1. If this element is an [input](#) element, and [selectionDirection does not apply](#) to this element, return null.
2. Return this element's [selection direction](#).

The [selectionDirection](#) attribute's setter must run the following steps:

1. If this element is an [input](#) element, and [selectionDirection does not apply](#) to this

element, throw an "[InvalidStateError](#)" [DOMException](#).

2. Set the selection range with the value of this element's [selectionStart](#) attribute, the value of this element's [selectionEnd](#) attribute, and the given value.

The [setSelectionRange\(start, end, direction\)](#) method, when invoked, must run the following steps:

1. If this element is an [input](#) element, and [setSelectionRange\(\) does not apply](#) to this element, throw an "[InvalidStateError](#)" [DOMException](#).
2. Set the selection range with *start*, *end*, and *direction*.

To set the selection range with an integer or null *start*, an integer or null or the special value infinity *end*, and optionally a string *direction*, run the following steps:

1. If *start* is null, let *start* be zero.
2. If *end* is null, let *end* be zero.
3. Set the [selection](#) of the text control to the sequence of [code units](#) within the [relevant value](#) starting with the code unit at the *start*th position (in logical order) and ending with the code unit at the (*end*-1)th position. Arguments greater than the [length](#) of the [relevant value](#) of the text control (including the special value infinity) must be treated as pointing at the end of the text control. If *end* is less than or equal to *start* then the start of the selection and the end of the selection must both be placed immediately before the character with offset *end*. In UAs where there is no concept of an empty selection, this must set the cursor to be just before the character with offset *end*.
4. If *direction* is not [identical to](#) either "backward" or "forward", or if the *direction* argument was not given, set *direction* to "none".
5. Set the [selection direction](#) of the text control to *direction*.
6. If the previous steps caused the [selection](#) of the text control to be modified (in either extent or [direction](#)), then [queue an element task](#) on the [user interaction task source](#) given the element to [fire an event](#) named [select](#) at the element, with the [bubbles](#) attribute initialized to true.

The [setRangeText\(replacement, start, end, selectMode\)](#) method, when invoked, must run the following steps:

1. If this element is an [input](#) element, and [setRangeText\(\) does not apply](#) to this element, throw an "[InvalidStateError](#)" [DOMException](#).
2. Set this element's [dirty value flag](#) to true.

3. If the method has only one argument, then let *start* and *end* have the values of the [**selectionStart**](#) attribute and the [**selectionEnd**](#) attribute respectively.

Otherwise, let *start*, *end* have the values of the second and third arguments respectively.

4. If *start* is greater than *end*, then throw an "[IndexSizeError](#)" [DOMException](#).
5. If *start* is greater than the [**length**](#) of the [**relevant value**](#) of the text control, then set it to the [**length**](#) of the [**relevant value**](#) of the text control.
6. If *end* is greater than the [**length**](#) of the [**relevant value**](#) of the text control, then set it to the [**length**](#) of the [**relevant value**](#) of the text control.
7. Let *selection start* be the current value of the [**selectionStart**](#) attribute.
8. Let *selection end* be the current value of the [**selectionEnd**](#) attribute.
9. If *start* is less than *end*, delete the sequence of [**code units**](#) within the element's [**relevant value**](#) starting with the code unit at the *start*th position and ending with the code unit at the (*end*-1)th position.
10. Insert the value of the first argument into the text of the [**relevant value**](#) of the text control, immediately before the *start*th [**code unit**](#).
11. Let *new length* be the [**length**](#) of the value of the first argument.
12. Let *new end* be the sum of *start* and *new length*.
13. Run the appropriate set of substeps from the following list:

If the fourth argument's value is "**select**"

Let *selection start* be *start*.

Let *selection end* be *new end*.

If the fourth argument's value is "**start**"

Let *selection start* and *selection end* be *start*.

If the fourth argument's value is "**end**"

Let *selection start* and *selection end* be *new end*.

If the fourth argument's value is "**preserve**"

If the method has only one argument

1. Let *old length* be *end* minus *start*.

2. Let *delta* be *new length* minus *old length*.
3. If *selection start* is greater than *end*, then increment it by *delta*. (If *delta* is negative, i.e. the new text is shorter than the old text, then this will *decrease* the value of *selection start*.)

Otherwise: if *selection start* is greater than *start*, then set it to *start*. (This snaps the start of the selection to the start of the new text if it was in the middle of the text that it replaced.)

4. If *selection end* is greater than *end*, then increment it by *delta* in the same way.

Otherwise: if *selection end* is greater than *start*, then set it to *new end*. (This snaps the end of the selection to the end of the new text if it was in the middle of the text that it replaced.)

14. Set the selection range with *selection start* and *selection end*.

The `setRangeText()` method uses the following enumeration:

```
enum SelectionMode {
  "select",
  "start",
  "end",
  "preserve" // default
};
```

To obtain the currently selected text, the following JavaScript suffices:

```
var selectionText = control.value.substring(control.selectionStart, control.s...
```

...where *control* is the `input` or `textarea` element.

To add some text at the start of a text control, while maintaining the text selection, the three attributes must be preserved:

```
var oldStart = control.selectionStart;
var oldEnd = control.selectionEnd;
var oldDirection = control.selectionDirection;
var prefix = "http://";
control.value = prefix + control.value;
control.setSelectionRange(oldStart + prefix.length, oldEnd + prefix.length, o...
```

...where *control* is the `input` or `textarea` element.

4.10.20 Constraints

4.10.20.1 Definitions

A [submittable element](#) is a *candidate for constraint validation* except when a condition has *barred the element from constraint validation*. (For example, an element is [barred from constraint validation](#) if it has a [datalist](#) element ancestor.)

An element can have a *custom validity error message* defined. Initially, an element must have its [custom validity error message](#) set to the empty string. When its value is not the empty string, the element is [suffering from a custom error](#). It can be set using the [setCustomValidity\(\)](#) method, except for [form-associated custom elements](#). [Form-associated custom elements](#) can have a [custom validity error message](#) set via their [ElementInternals](#) object's [setValidity\(\)](#) method. The user agent should use the [custom validity error message](#) when alerting the user to the problem with the control.

An element can be constrained in various ways. The following is the list of *validity states* that a form control can be in, making the control invalid for the purposes of constraint validation. (The definitions below are non-normative; other parts of this specification define more precisely when each state applies or does not.)

Suffering from being missing

When a control has no [value](#) but has a [required](#) attribute ([input required](#), [textarea required](#)); or, more complicated rules for [select](#) elements and controls in [radio button groups](#), as specified in their sections.

When the [setValidity\(\)](#) method sets [valueMissing](#) flag to true for a [form-associated custom element](#).

Suffering from a type mismatch

When a control that allows arbitrary user input has a [value](#) that is not in the correct syntax ([Email](#), [URL](#)).

When the [setValidity\(\)](#) method sets [typeMismatch](#) flag to true for a [form-associated custom element](#).

Suffering from a pattern mismatch

When a control has a [value](#) that doesn't satisfy the [pattern](#) attribute.

When the [setValidity\(\)](#) method sets [patternMismatch](#) flag to true for a [form-associated custom element](#).

Suffering from being too long

When a control has a [value](#) that is too long for the [form control maxlen attribute](#) ([input maxlen](#), [textarea maxlen](#)).

When the [setValidity\(\)](#) method sets [tooLong](#) flag to true for a [form-associated custom element](#).

Suffering from being too short

When a control has a [value](#) that is too short for the [form control minlength attribute](#) ([input minlength](#), [textarea minlength](#)).

When the [setValidity\(\)](#) method sets [tooShort](#) flag to true for a [form-associated custom element](#).

Suffering from an underflow

When a control has a [value](#) that is not the empty string and is too low for the [min](#) attribute.

When the [setValidity\(\)](#) method sets [rangeUnderflow](#) flag to true for a [form-associated custom element](#).

Suffering from an overflow

When a control has a [value](#) that is not the empty string and is too high for the [max](#) attribute.

When the [setValidity\(\)](#) method sets [rangeOverflow](#) flag to true for a [form-associated custom element](#).

Suffering from a step mismatch

When a control has a [value](#) that doesn't fit the rules given by the [step](#) attribute.

When the [setValidity\(\)](#) method sets [stepMismatch](#) flag to true for a [form-associated custom element](#).

Suffering from bad input

When a control has incomplete input and the user agent does not think the user ought to be able to submit the form in its current state.

When the [setValidity\(\)](#) method sets [badInput](#) flag to true for a [form-associated custom element](#).

Suffering from a custom error

When a control's [custom validity error message](#) (as set by the element's [setCustomValidity\(\)](#) method or [ElementInternals's setValidity\(\)](#) method) is not the empty string.

An element can still suffer from these states even when the element is [disabled](#); thus these states can be represented in the DOM even if validating the form during submission wouldn't indicate a problem to the user.

An element *satisfies its constraints* if it is not suffering from any of the above [validity states](#).

4.10.20.2 Constraint validation

When the user agent is required to *statically validate the constraints* of [form](#) element *form*, it must run the following steps, which return either a *positive* result (all the controls in the form are valid) or a *negative* result (there are invalid controls) along with a (possibly empty) list of elements that are invalid and for which no script has claimed responsibility:

1. Let *controls* be a list of all the [submittable elements](#) whose [form owner](#) is *form*, in [tree order](#).
2. Let *invalid controls* be an initially empty list of elements.
3. For each element *field* in *controls*, in [tree order](#):
 1. If *field* is not a [candidate for constraint validation](#), then move on to the next element.
 2. Otherwise, if *field* [satisfies its constraints](#), then move on to the next element.
 3. Otherwise, add *field* to *invalid controls*.
4. If *invalid controls* is empty, then return a *positive* result.
5. Let *unhandled invalid controls* be an initially empty list of elements.
6. For each element *field* in *invalid controls*, if any, in [tree order](#):
 1. Let *notCanceled* be the result of [firing an event named `invalid`](#) at *field*, with the [cancelable](#) attribute initialized to true.
 2. If *notCanceled* is true, then add *field* to *unhandled invalid controls*.
7. Return a *negative* result with the list of elements in the *unhandled invalid controls* list.

If a user agent is to *interactively validate the constraints* of [form](#) element *form*, then the user agent must run the following steps:

1. Statically validate the constraints of *form*, and let *unhandled invalid controls* be the list of elements returned if the result was *negative*.
2. If the result was *positive*, then return that result.
3. Report the problems with the constraints of at least one of the elements given in *unhandled invalid controls* to the user.
 - User agents may focus one of those elements in the process, by running the focusing steps for that element, and may change the scrolling position of the document, or perform some other action that brings the element to the user's attention. For elements that are form-associated custom elements, user agents should use their validation anchor instead, for the purposes of these actions.
 - User agents may report more than one constraint violation.
 - User agents may coalesce related constraint violation reports if appropriate (e.g. if multiple radio buttons in a group are marked as required, only one error need be reported).
 - If one of the controls is not being rendered (e.g. it has the hidden attribute set) then user agents may report a script error.
4. Return a *negative* result.

4.10.20.3 The *constraint validation API*

`element.willValidate`

✓MDN

[HTMLObjectElement/willValidate](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 4+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 4+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns true if the element will be validated when the form is submitted; false otherwise.

`element.setCustomValidity(message)`

✓MDN

[HTMLObjectElement/setCustomValidity](#)

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 10+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

[HTMLSelectElement/setCustomValidity](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 4+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 4+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Sets a custom error, so that the element would fail to validate. The given message is the message to be shown to the user when reporting the problem to the user.

If the argument is the empty string, clears the custom error.

`element.validity.valueMissing`

Returns true if the element has no value but is a required field; false otherwise.

`element.validity.typeMismatch`

Returns true if the element's value is not in the correct syntax; false otherwise.

`element.validity.patternMismatch`

Returns true if the element's value doesn't match the provided pattern; false otherwise.

`element.validity.tooLong`

✓MDN

[ValidityState/tooLong](#)

Support in all current engines.

Firefox 4+ Safari 11+ Chrome 15+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 64+ Safari iOS 5+ Chrome Android 18+ WebView Android 4+ Samsung

Internet1.0+Opera Android14+

Returns true if the element's value is longer than the provided maximum length; false otherwise.

`element.validity.tooShort`

✓MDN

[ValidityState/tooShort](#)

Support in all current engines.

Firefox51+Safari11+Chrome40+

Opera27+Edge79+

Edge (Legacy)17+Internet ExplorerNo

Firefox Android64+Safari iOS10+Chrome Android40+WebView Android67+Samsung

Internet4.0+Opera Android27+

Returns true if the element's value, if it is not the empty string, is shorter than the provided minimum length; false otherwise.

`element.validity.rangeUnderflow`

Returns true if the element's value is lower than the provided minimum; false otherwise.

`element.validity.rangeOverflow`

Returns true if the element's value is higher than the provided maximum; false otherwise.

`element.validity.stepMismatch`

Returns true if the element's value doesn't fit the rules given by the `step` attribute; false otherwise.

`element.validity.badInput`

✓MDN

[ValidityState/badInput](#)

Support in all current engines.

Firefox 29+ Safari 11+ Chrome 25+

Opera 15+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 64+ Safari iOS 7+ Chrome Android 25+ WebView Android 4.4+ Samsung

Internet 1.5+ Opera Android 14+

Returns true if the user has provided input in the user interface that the user agent is unable to convert to a value; false otherwise.

`element.validity.customError`

Returns true if the element has a custom error; false otherwise.

`element.validity.valid`

Returns true if the element's value has no validity problems; false otherwise.

`valid = element.checkValidity()`

✓MDN

[HTMLObjectElement/checkValidity](#)

Support in all current engines.

Firefox4+Safari5.1+Chrome10+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

[HTMLSelectElement/checkValidity](#)

Support in all current engines.

Firefox4+Safari5+Chrome4+

Opera9+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android4+Safari iOS4+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android10.1+

Returns true if the element's value has no validity problems; false otherwise. Fires an [invalid](#) event at the element in the latter case.

`valid = element.reportValidity()`

✓MDN

[HTMLFormElement/reportValidity](#)

Support in all current engines.

Firefox49+Safari10.1+Chrome40+

Opera27+Edge79+

Edge (Legacy)17+Internet ExplorerNo

Firefox Android49+Safari iOS10.3+Chrome Android40+WebView Android40+Samsung Internet4.0+Opera Android27+

Returns true if the element's value has no validity problems; otherwise, returns false, fires an [invalid](#) event at the element, and (if the event isn't canceled) reports the problem to the user.

`element.validationMessage`

✓MDN

[HTMLObjectElement/validationMessage](#)

Support in all current engines.

Firefox 4+ Safari 5.1+ Chrome 10+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the error message that would be shown to the user if the element was to be checked for validity.

The `willValidate` attribute's getter must return true, if this element is a [candidate for constraint validation](#), and false otherwise (i.e., false if any conditions are [barring it from constraint validation](#)).

MDN

[ElementInternals/willValidate](#)

Support in one engine only.

Firefox No Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

The `willValidate` attribute of [ElementInternals](#) interface, on getting, must throw a ["NotSupportedError" DOMException](#) if the [target element](#) is not a [form-associated custom element](#). Otherwise, it must return true if the [target element](#) is a [candidate for constraint validation](#), and false otherwise.

The `setCustomValidity(error)` method, when invoked, must set the [custom validity error message](#) to `error`.

In the following example, a script checks the value of a form control each time it is edited, and whenever it is not a valid value, uses the [setCustomValidity\(\)](#) method to set an appropriate message.

```
<label>Feeling: <input name=f type="text" oninput="check(this)"></label>
<script>
  function check(input) {
    if (input.value == "good" ||
        input.value == "fine" ||
        input.value == "great" ||
        input.value == "wonderful") {
      input.setCustomValidity("");
    } else {
      input.setCustomValidity("Please enter a positive response.");
    }
  }
</script>
```

```
        input.value == "tired") {
    input.setCustomValidity("'" + input.value + "' is not a feeling.'");
} else {
    // input is fine -- reset the error message
    input.setCustomValidity('');
}
}
</script>
```

✓MDN

[HTMLObjectElement/validity](#)

Support in all current engines.

Firefox4+Safari5.1+Chrome10+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

The *validity* attribute's getter must return a [ValidityState](#) object that represents the [validity states](#) of this element. This object is [live](#).

⚠MDN

[ElementInternals/validity](#)

Support in one engine only.

FirefoxNoSafariNoChrome77+

Opera64+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOSNoChrome Android77+WebView Android77+Samsung

Internet12.0+Opera Android55+

The *validity* attribute of [ElementInternals](#) interface, on getting, must throw a ["NotSupportedError" DOMException](#) if the [target element](#) is not a [form-associated custom element](#). Otherwise, it must return a [ValidityState](#) object that represents the [validity states](#) of the [target element](#). This object is [live](#).

```
[Exposed=Window]
interface ValidityState {
    readonly attribute boolean valueMissing;
    readonly attribute boolean typeMismatch;
    readonly attribute boolean patternMismatch;
```

```
readonly attribute boolean tooLong;  
readonly attribute boolean tooShort;  
readonly attribute boolean rangeUnderflow;  
readonly attribute boolean rangeOverflow;  
readonly attribute boolean stepMismatch;  
readonly attribute boolean badInput;  
readonly attribute boolean customError;  
readonly attribute boolean valid;  
};
```

A [ValidityState](#) object has the following attributes. On getting, they must return true if the corresponding condition given in the following list is true, and false otherwise.

valueMissing

The control is [suffering from being missing](#).

typeMismatch



[ValidityState/typeMismatch](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 15+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The control is [suffering from a type mismatch](#).

patternMismatch



[ValidityState/patternMismatch](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 15+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The control is [suffering from a pattern mismatch](#).

tooLong

The control is [suffering from being too long](#).

tooShort

The control is [suffering from being too short](#).

rangeUnderflow

✓MDN

[ValidityState/rangeUnderflow](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 15+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The control is [suffering from an underflow](#).

rangeOverflow

✓MDN

[ValidityState/rangeOverflow](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 15+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The control is [suffering from an overflow](#).

stepMismatch

✓MDN

[ValidityState/stepMismatch](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 15+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

The control is [suffering from a step mismatch](#).

badInput

The control is [suffering from bad input](#).

customError

The control is [suffering from a custom error](#).

valid

None of the other conditions are true.

The *check validity steps* for an element *element* are:

1. If *element* is a [candidate for constraint validation](#) and does not [satisfy its constraints](#), then:
 1. [Fire an event](#) named [invalid](#) at *element*, with the [cancelable](#) attribute initialized to true (though canceling has no effect).
 2. Return false.
2. Return true.

The *checkValidity()* method, when invoked, must run the [check validity steps](#) on this element.

MDN

[ElementInternals/checkValidity](#)

Support in one engine only.

FirefoxNoSafariNoChrome77+

Opera64+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOSNoChrome Android77+WebView Android77+Samsung Internet12.0+Opera Android55+

The *checkValidity()* method of the [ElementInternals](#) interface must run these steps:

1. Let *element* be this [ElementInternals](#)'s target element.
2. If *element* is not a [form-associated custom element](#), then throw a ["NotSupportedError" DOMException](#).
3. Run the [check validity steps](#) on *element*.

The *report validity steps* for an element *element* are:

1. If *element* is a [candidate for constraint validation](#) and does not [satisfy its constraints](#), then:
 1. Let *report* be the result of [firing an event](#) named [invalid](#) at *element*, with the [cancelable](#) attribute initialized to true.
 2. If *report* is true, then report the problems with the constraints of this element to the user. When reporting the problem with the constraints to the user, the user agent may run the [focusing steps](#) for *element*, and may change the scrolling position of the document, or perform some other action that brings *element* to the user's attention. User agents may report more than one constraint violation, if *element* suffers from multiple problems at once. If *element* is not [being rendered](#), then the user agent may, instead of notifying the user, [report the error for the running script](#).
 3. Return false.
2. Return true.

The *reportValidity()* method, when invoked, must run the [report validity steps](#) on this element.

ΔMDN

[ElementInternals/reportValidity](#)

Support in one engine only.

Firefox No Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

The *reportValidity()* method of the [ElementInternals](#) interface must run these steps:

1. Let *element* be this [ElementInternals](#)'s target element.

2. If *element* is not a [form-associated custom element](#), then throw a ["NotSupportedError" DOMException](#).
3. Run the [report validity steps](#) on *element*.

The ***validationMessage*** attribute's getter must run these steps:

1. If this element is not a [candidate for constraint validation](#) or if this element [satisfies its constraints](#), then return the empty string.
2. Return a suitably localized message that the user agent would show the user if this were the only form control with a validity constraint problem. If the user agent would not actually show a textual message in such a situation (e.g., it would show a graphical cue instead), then return a suitably localized message that expresses (one or more of) the validity constraint(s) that the control does not satisfy. If the element is a [candidate for constraint validation](#) and is [suffering from a custom error](#), then the [custom validity error message](#) should be present in the return value.

4.10.20.4 Security

Servers should not rely on client-side validation. Client-side validation can be intentionally bypassed by hostile users, and unintentionally bypassed by users of older user agents or automated tools that do not implement these features. The constraint validation features are only intended to improve the user experience, not to provide any kind of security mechanism.

4.10.21 Form submission

4.10.21.1 Introduction

This section is non-normative.

When a form is submitted, the data in the form is converted into the structure specified by the [enctype](#), and then sent to the destination specified by the [action](#) using the given [method](#).

For example, take the following form:

```
<form action="/find.cgi" method=get>
  <input type=text name=t>
  <input type=search name=q>
  <input type=submit>
</form>
```

If the user types in "cats" in the first field and "fur" in the second, and then hits the submit button, then the user agent will load `/find.cgi?t=cats&q=fur`.

On the other hand, consider this form:

```
<form action="/find.cgi" method=post enctype="multipart/form-data">
  <input type=text name=t>
  <input type=search name=q>
  <input type=submit>
</form>
```

Given the same user input, the result on submission is quite different: the user agent instead does an HTTP POST to the given URL, with as the entity body something like the following text:

```
-----kYFrd4jNJEgCervE
Content-Disposition: form-data; name="t"

cats
-----kYFrd4jNJEgCervE
Content-Disposition: form-data; name="q"

fur
-----kYFrd4jNJEgCervE--
```

4.10.21.2 Implicit submission

A [form](#) element's *default button* is the first [submit button](#) in [tree order](#) whose [form owner](#) is that [form](#) element.

If the user agent supports letting the user submit a form implicitly (for example, on some platforms hitting the "enter" key while a text control is [focused](#) implicitly submits the form), then doing so for a form, whose [default button](#) has [activation behavior](#) and is not [disabled](#), must cause the user agent to [fire a click event](#) at that [default button](#).

There are pages on the web that are only usable if there is a way to implicitly submit forms, so user agents are strongly encouraged to support this.

If the form has no [submit button](#), then the implicit submission mechanism must do nothing if the form has more than one *field that blocks implicit submission*, and must [submit](#) the [form](#) element from the [form](#) element itself otherwise.

For the purpose of the previous paragraph, an element is a *field that blocks implicit submission* of a [form](#) element if it is an [input](#) element whose [form owner](#) is that [form](#) element and whose [type](#) attribute is in one of the following states: [Text](#), [Search](#), [URL](#), [Telephone](#), [Email](#), [Password](#), [Date](#), [Month](#), [Week](#), [Time](#), [Local Date and Time](#), [Number](#)

4.10.21.3 Form submission algorithm

Each [form](#) element has a *constructing entry list* boolean, initially false.

Each [form](#) element has a *firing submission events* boolean, initially false.

When a `form` element *form* is *submitted* from an element *submitter* (typically a button), optionally with a *submitted from `submit()`* method flag set, the user agent must run the following steps:

1. If *form* [cannot navigate](#), then return.
2. If *form*'s [constructing entry list](#) is true, then return.
3. Let *form document* be *form*'s [node document](#).
4. If *form document*'s [active sandboxing flag set](#) has its [sandboxed forms browsing context flag](#) set, then return.
5. Let *form browsing context* be the [browsing context](#) of *form document*.
6. If the *submitted from `submit()`* method flag is not set, then:
 1. If *form*'s [firing submission events](#) is true, then return.
 2. Set *form*'s [firing submission events](#) to true.
 3. If the *submitter* element's [no-validate state](#) is false, then [interactively validate the constraints](#) of *form* and examine the result. If the result is negative (i.e., the constraint validation concluded that there were invalid fields and probably informed the user of this), then:
 1. Set *form*'s [firing submission events](#) to false.
 2. Return.
 4. Let *submitterButton* be null if *submitter* is *form*. Otherwise, let *submitterButton* be *submitter*.
 5. Let *shouldContinue* be the result of [firing an event](#) named `submit` at *form* using `SubmitEvent`, with the [submitter](#) attribute initialized to *submitterButton*, the [bubbles](#) attribute initialized to true, and the [cancelable](#) attribute initialized to true.
 6. Set *form*'s [firing submission events](#) to false.
 7. If *shouldContinue* is false, then return.
 8. If *form* [cannot navigate](#), then return.
9. [Cannot navigate](#) is run again as dispatching the `submit` event could have changed the outcome.
10. Let *encoding* be the result of [picking an encoding for the form](#).

8. Let *entry list* be the result of [constructing the entry list](#) with *form*, *submitter*, and *encoding*.

9. If *form* [cannot navigate](#), then return.

[Cannot navigate](#) is run again as dispatching the [formdata](#) event in [constructing the entry list](#) could have changed the outcome.

10. Let *action* be the *submitter* element's [action](#).

11. If *action* is the empty string, let *action* be the [URL](#) of the *form document*.

12. [Parse a URL](#) given *action*, relative to the *submitter* element's [node document](#). If this fails, return.

13. Let *parsed action* be the [resulting URL record](#).

14. Let *scheme* be the [scheme](#) of *parsed action*.

15. Let *enctype* be the *submitter* element's [enctype](#).

16. Let *method* be the *submitter* element's [method](#).

17. Let *target* be the *submitter* element's [formtarget](#) attribute value, if the element is a [submit button](#) and has such an attribute. Otherwise, let it be the result of [getting an element's target](#) given *submitter*'s [form owner](#).

18. Let *noopener* be the result of [getting an element's noopener](#) with *form* and *target*.

19. Let *target browsing context* and *windowType* be the result of applying [the rules for choosing a browsing context](#) using *target*, *form browsing context*, and *noopener*.

20. Let *historyHandling* be "[replace](#)" if *windowType* is either "[new and unrestricted](#)" or "[new with no opener](#)"; otherwise "[default](#)".

21. If *target browsing context* is null, then return.

22. If *form document* has not yet [completely loaded](#), then set *historyHandling* to "[replace](#)".

23. If the value of *method* is [dialog](#) then jump to the [submit dialog](#) steps.

Otherwise, select the appropriate row in the table below based on the value of *scheme* as given by the first cell of each row. Then, select the appropriate cell on that row based on the value of *method* as given in the first cell of each column. Then, jump to the steps named in that cell and defined below the table.

	<u>GET</u>	<u>POST</u>
http	Mutate action URL	Submit as entity body
https	Mutate action URL	Submit as entity body
ftp	Get action URL	Get action URL
javascript	Get action URL	Get action URL
data	Mutate action URL	Get action URL
mailto	Mail with headers	Mail as body

If *scheme* is not one of those listed in this table, then the behavior is not defined by this specification. User agents should, in the absence of another specification defining this, act in a manner analogous to that defined in this specification for similar schemes.

Each [form](#) element has a *planned navigation*, which is either null or a [task](#); when the [form](#) is first created, its [planned navigation](#) must be set to null. In the behaviors described below, when the user agent is required to *plan to navigate* to a particular resource *destination*, it must run the following steps:

1. If *destination* is not a [request](#), then set *destination* to a new [request](#) whose [URL](#) is *destination*.
2. If the [form](#) element's [link types](#) include the [noreferrer](#) keyword, then set *destination*'s [referrer](#) to "no-referrer".
3. If the [form](#) has a non-null [planned navigation](#), remove it from its [task queue](#).
4. [Queue an element task](#) on the [DOM manipulation task source](#) given the [form](#) element and the following steps:
 1. Set the [form](#)'s [planned navigation](#) to null.
 2. [Navigate](#) target browsing context to *destination*, with [historyHandling](#) set to *historyHandling* and [navigationType](#) set to "form-submission".
5. Set the [form](#)'s [planned navigation](#) to the just-queued [task](#).

The behaviors are as follows:

Mutate action URL

Let *pairs* be the result of [converting to a list of name-value pairs](#) with *entry list*.

Let *query* be the result of running the [application/x-www-form-urlencoded serializer](#) with *pairs* and *encoding*.

Set *parsed action*'s [query](#) component to *query*.

Plan to navigate to parsed action.

Submit as entity body

Switch on *enctype*:

application/x-www-form-urlencoded

Let *pairs* be the result of converting to a list of name-value pairs with *entry list*.

Let *body* be the result of running the application/x-www-form-urlencoded serializer with *pairs* and *encoding*.

Set *body* to the result of encoding *body*.

Let *mimeType* be 'application/x-www-form-urlencoded'.

multipart/form-data

Let *body* be the result of running the multipart/form-data encoding algorithm with *entry list* and *encoding*.

Let *mimeType* be the isomorphic encoding of the concatenation of "multipart/form-data; boundary=" and the multipart/form-data boundary string generated by the multipart/form-data encoding algorithm.

text/plain

Let *pairs* be the result of converting to a list of name-value pairs with *entry list*.

Let *body* be the result of running the text/plain encoding algorithm with *pairs*.

Set *body* to the result of encoding *body* using *encoding*.

Let *mimeType* be 'text/plain'.

Plan to navigate to a new request whose URL is *parsed action*, method is *method*, header list is « ('Content-Type', *mimeType*) », and body is *body*.

Get action URL

Plan to navigate to parsed action.

entry list is discarded.

Mail with headers

Let *pairs* be the result of [converting to a list of name-value pairs](#) with *entry list*.

Let *headers* be the result of running the [**application/x-www-form-urlencoded** serializer](#) with *pairs* and *encoding*.

Replace occurrences of U+002B PLUS SIGN characters (+) in *headers* with the string "%20".

Set *parsed action's query* to *headers*.

[Plan to navigate](#) to *parsed action*.

Mail as body

Let *pairs* be the result of [converting to a list of name-value pairs](#) with *entry list*.

Switch on *enctype*:

[**text/plain**](#)

Let *body* be the result of running the [**text/plain** encoding algorithm](#) with *pairs*.

Set *body* to the result of running [UTF-8 percent-encode](#) on *body* using the [default encode set](#). [\[URL\]](#)

Otherwise

Let *body* be the result of running the [**application/x-www-form-urlencoded** serializer](#) with *pairs* and *encoding*.

If *parsed action's query* is null, then set it to the empty string.

If *parsed action's query* is not the empty string, then append a single U+0026 AMPERSAND character (&) to it.

Append "body=" to *parsed action's query*.

Append *body* to *parsed action's query*.

[Plan to navigate](#) to *parsed action*.

Submit dialog

Let *subject* be the nearest ancestor [**dialog**](#) element of *form*, if any.

If there isn't one, or if it does not have an [open](#) attribute, do nothing. Otherwise, proceed as follows:

If *submitter* is an [input](#) element whose [type](#) attribute is in the [Image Button](#) state, then let *result* be the string formed by concatenating the [selected coordinate](#)'s *x*-component, expressed as a base-ten number using [ASCII digits](#), a U+002C COMMA character (,), and the [selected coordinate](#)'s *y*-component, expressed in the same way as the *x*-component.

Otherwise, if *submitter* has a [value](#), then let *result* be that [value](#).

Otherwise, there is no *result*.

Then, [close the dialog](#) *subject*. If there is a *result*, let that be the return value.

4.10.21.4 Constructing the entry list

The algorithm to *construct the entry list* given a *form*, an optional *submitter*, and an optional *encoding*, is as follows. If not specified otherwise, *submitter* is null.

1. If *form*'s [constructing entry list](#) is true, then return null.
2. Set *form*'s [constructing entry list](#) to true.
3. Let *controls* be a list of all the [submittable elements](#) whose [form owner](#) is *form*, in [tree order](#).
4. Let *entry list* be a new empty [list](#) of [entries](#).
5. For each element *field* in *controls*, in [tree order](#):
 1. If any of the following is true:
 - The *field* element has a [datalist](#) element ancestor.
 - The *field* element is [disabled](#).
 - The *field* element is a [button](#) but it is not *submitter*.
 - The *field* element is an [input](#) element whose [type](#) attribute is in the [Checkbox](#) state and whose [checkedness](#) is false.
 - The *field* element is an [input](#) element whose [type](#) attribute is in the [Radio Button](#) state and whose [checkedness](#) is false.

Then [continue](#).

2. If the *field* element is an [input](#) element whose [type](#) attribute is in the [Image Button](#) state, then:
 1. If the *field* element has a [name](#) attribute specified and its value is not the

empty string, let *name* be that value followed by a single U+002E FULL STOP character (.). Otherwise, let *name* be the empty string.

2. Let $name_x$ be the string consisting of the concatenation of *name* and a single U+0078 LATIN SMALL LETTER X character (x).
 3. Let $name_y$ be the string consisting of the concatenation of *name* and a single U+0079 LATIN SMALL LETTER Y character (y).
 4. The *field* element is *submitter*, and before this algorithm was invoked the user [indicated a coordinate](#). Let *x* be the *x*-component of the coordinate selected by the user, and let *y* be the *y*-component of the coordinate selected by the user.
 5. [Append an entry](#) to *entry list* with $name_x$ and *x*.
 6. [Append an entry](#) to *entry list* with $name_y$ and *y*.
 7. [Continue](#).
3. If the *field* is a [form-associated custom element](#), then perform the [entry construction algorithm](#) given *field* and *entry list*, then [continue](#).
 4. If either the *field* element does not have a [name](#) attribute specified, or its [name](#) attribute's value is the empty string, then [continue](#).
 5. Let *name* be the value of the *field* element's [name](#) attribute.
 6. If the *field* element is a [select](#) element, then for each [option](#) element in the [select](#) element's [list of options](#) whose [selectedness](#) is true and that is not [disabled](#), [append an entry](#) to *entry list* with *name* and the [value](#) of the [option](#) element.
 7. Otherwise, if the *field* element is an [input](#) element whose [type](#) attribute is in the [Checkbox](#) state or the [Radio Button](#) state, then:
 1. If the *field* element has a [value](#) attribute specified, then let *value* be the value of that attribute; otherwise, let *value* be the string "on".
 2. [Append an entry](#) to *entry list* with *name* and *value*.
 8. Otherwise, if the *field* element is an [input](#) element whose [type](#) attribute is in the [File Upload](#) state, then:
 1. If there are no [selected files](#), then [append an entry](#) to *entry list* with *name* and a new [File](#) object with an empty name, [application/octet-stream](#) as type, and an empty body.

2. Otherwise, for each file in [selected files](#), [append an entry](#) to *entry list* with *name* and a [File](#) object representing the file.
9. Otherwise, if the *field* element is an [input](#) element whose [type](#) attribute is in the [Hidden](#) state and *name* is an ASCII case-insensitive match for "[_charset_](#)":
 1. Let *charset* be the [name](#) of *encoding* if *encoding* is given, and "UTF-8" otherwise.
 2. [Append an entry](#) to *entry list* with *name* and *charset*.
10. Otherwise, [append an entry](#) to *entry list* with *name* and the [value](#) of the *field* element.
11. If the element has a [dirname](#) attribute, and that attribute's value is not the empty string, then:
 1. Let *dirname* be the value of the element's [dirname](#) attribute.
 2. Let *dir* be the string "ltr" if [the directionality](#) of the element is 'ltr', and "rtl" otherwise (i.e., when [the directionality](#) of the element is 'rtl').
 3. [Append an entry](#) to *entry list* with *dirname* and *dir*.

An element can only have a [dirname](#) attribute if it is a [textarea](#) element or an [input](#) element whose [type](#) attribute is in either the [Text](#) state or the [Search](#) state.

6. Let *form data* be a new [FormData](#) object associated with *entry list*.
7. [Fire an event](#) named [formdata](#) at *form* using [FormDataEvent](#), with the [formData](#) attribute initialized to *form data* and the [bubbles](#) attribute initialized to true.
8. Set *form*'s [constructing entry list](#) to false.
9. Return a [clone](#) of *entry list*.

To [append an entry](#) to *entry list*, given *name* and *value*, run these steps:

1. Set *name* to the result of [converting](#) *name* into a scalar value string.
2. If *value* is not a [File](#) object, then set *value* to the result of [converting](#) *value* into a scalar value string.
3. [Create an entry](#) with *name* and *value*, and [append](#) it to *entry list*.

4.10.21.5 Selecting a form submission encoding

If the user agent is to *pick an encoding for a form*, it must run the following steps:

1. Let *encoding* be the [document's character encoding](#).
2. If the [form](#) element has an [accept-charset](#) attribute, set *encoding* to the return value of running these substeps:
 1. Let *input* be the value of the [form](#) element's [accept-charset](#) attribute.
 2. Let *candidate encoding labels* be the result of [splitting input on ASCII whitespace](#).
 3. Let *candidate encodings* be an empty list of [character encodings](#).
 4. For each token in *candidate encoding labels* in turn (in the order in which they were found in *input*), [get an encoding](#) for the token and, if this does not result in failure, append the [encoding](#) to *candidate encodings*.
 5. If *candidate encodings* is empty, return [UTF-8](#).
 6. Return the first encoding in *candidate encodings*.
3. Return the result of [getting an output encoding](#) from *encoding*.

4.10.21.6 Converting an entry list to a list of name-value pairs

The [application/x-www-form-urlencoded](#) and [text/plain](#) encoding algorithms take a list of name-value pairs, where the values must be strings, rather than an entry list where the value can be a [File](#). The following algorithm performs the conversion.

To convert to a list of name-value pairs an entry list *entry list*, run these steps:

1. Let *list* be an empty [list](#) of name-value pairs.
2. [For each](#) entry of *entry list*:
 1. Let *name* be *entry*'s name, with every occurrence of U+000D (CR) not followed by U+000A (LF), and every occurrence of U+000A (LF) not preceded by U+000D (CR), replaced by a string consisting of U+000D (CR) and U+000A (LF).
 2. If *entry*'s value is a [File](#) object, then let *value* be *entry*'s value's [name](#). Otherwise, let *value* be *entry*'s value.
 3. Replace every occurrence of U+000D (CR) not followed by U+000A (LF), and every occurrence of U+000A (LF) not preceded by U+000D (CR), in *value*, by a

string consisting of U+000D (CR) and U+000A (LF).

4. Append to *list* a new name-value pair whose name is *name* and whose value is *value*.
3. Return *list*.

4.10.21.7 URL-encoded form data

See *URL* for details on [application/x-www-form-urlencoded](#).[\[URL\]](#)

4.10.21.8 Multipart form data

The *multipart/form-data* encoding algorithm, given an *entry list* and *encoding*, is as follows:

1. For each entry of *entry list*:
 1. Replace every occurrence of U+000D (CR) not followed by U+000A (LF), and every occurrence of U+000A (LF) not preceded by U+000D (CR), in *entry*'s name, by a string consisting of a U+000D (CR) and U+000A (LF).
 2. If *entry*'s value is not a [File](#) object, then replace every occurrence of U+000D (CR) not followed by U+000A (LF), and every occurrence of U+000A (LF) not preceded by U+000D (CR), in *entry*'s value, by a string consisting of a U+000D (CR) and U+000A (LF).
2. Return the byte sequence resulting from encoding the *entry list* using the rules described by RFC 7578, *Returning Values from Forms: multipart/form-data*, given the following conditions: [\[RFC7578\]](#)
 - Each entry in *entry list* is a *field*, the name of the entry is the *field name* and the value of the entry is the *field value*.
 - The order of parts must be the same as the order of fields in *entry list*. Multiple entries with the same name must be treated as distinct fields.
 - Field names, field values for non-file fields, and filenames for file fields, in the generated *multipart/form-data* resource must be set to the result of encoding the corresponding entry's name or value with *encoding*, converted to a byte sequence.
 - For field names and filenames for file fields, the result of the encoding in the previous bullet point must be escaped by replacing any 0x0A (LF) bytes with the byte sequence '%0A', 0x0D (CR) with '%0D' and 0x22 ("") with '%22'. The user agent must not perform any other escapes.

- The parts of the generated [multipart/form-data](#) resource that correspond to non-file fields must not have a '[Content-Type](#)' header specified.
- The boundary used by the user agent in generating the return value of this algorithm is the *multipart/form-data boundary string*. (This value is used to generate the MIME type of the form submission payload generated by this algorithm.)

For details on how to interpret [multipart/form-data](#) payloads, see RFC 7578. [\[RFC7578\]](#)

4.10.21.9 Plain text form data

The *text/plain encoding algorithm*, given a list of name-value pairs *pairs*, is as follows:

1. Let *result* be the empty string.
2. For each *pair* in *pairs*:
 1. Append *pair*'s name to *result*.
 2. Append a single U+003D EQUALS SIGN character (=) to *result*.
 3. Append *pair*'s value to *result*.
 4. Append a U+000D CARRIAGE RETURN (CR) U+000A LINE FEED (LF) character pair to *result*.
3. Return *result*.

Payloads using the [text/plain](#) format are intended to be human readable. They are not reliably interpretable by computer, as the format is ambiguous (for example, there is no way to distinguish a literal newline in a value from the newline at the end of the value).

4.10.21.10 The [SubmitEvent](#) interface



[SubmitEvent](#)

Support in all current engines.

Firefox 75+ Safari 15+ Chrome 81+

Opera? Edge 81+

Edge (Legacy) No Internet Explorer No

Firefox Android? Safari iOS 15+ Chrome Android 81+ WebView Android 81+ Samsung Internet 13.0+ Opera Android?



[SubmitEvent/SubmitEvent](#)

Support in all current engines.

Firefox 75+ Safari 15+ Chrome 81+

Opera? Edge 81+

Edge (Legacy) No Internet Explorer No

Firefox Android? Safari iOS 15+ Chrome Android 81+ WebView Android 81+ Samsung Internet 13.0+ Opera Android?

```
[Exposed=Window]
interface SubmitEvent : Event {
  constructor(DOMString type, optional SubmitEventInit eventInitDict = {});

  readonly attribute HTMLElement? submitter;
};

dictionary SubmitEventInit : EventInit {
  HTMLElement? submitter = null;
};

event.submitter
```

Returns the element representing the [submit button](#) that triggered the [form submission](#), or null if the submission was not triggered by a button.

The `submitter` attribute must return the value it was initialized to.

4.10.21.11 The [FormDataEvent](#) interface



[FormDataEvent/FormDataEvent](#)

Support in all current engines.

Firefox 72+ Safari 15+ Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 15+ Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

[FormDataEvent](#)

Support in all current engines.

Firefox 72+ Safari 15+ Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 15+ Chrome Android 77+ WebView Android 77+ Samsung

Internet 12.0+ Opera Android 55+

```
[Exposed=Window]
interface FormDataEvent : Event {
  constructor(DOMString type, FormDataEventInit eventInitDict);

  readonly attribute FormData formData;
};

dictionary FormDataEventInit : EventInit {
  required FormData formData;
};

event.formData
```

Returns a [FormData](#) object representing names and values of elements associated to the target [form](#). Operations on the [FormData](#) object will affect form data to be submitted.

The [formData](#) attribute must return the value it was initialized to. It represents a [FormData](#) object associated to the entry list that is [constructed](#) when the [form](#) is submitted.

4.10.22 Resetting a form

When a [form](#) element *form* is *reset*, run these steps:

1. Let *reset* be the result of [firing an event](#) named [reset](#) at *form*, with the [bubbles](#) and [cancelable](#) attributes initialized to true.
2. If *reset* is true, then invoke the [reset algorithm](#) of each [resettable element](#) whose [form owner](#) is *form*.

Each [resettable element](#) defines its own *reset algorithm*. Changes made to form controls as part of these algorithms do not count as changes caused by the user (and thus, e.g., do not cause [input](#) events to fire).

4.11 Interactive elements

4.11.1 The **details** element

[Element/details](#)

Support in all current engines.

Firefox 49+ Safari 6+ Chrome 12+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 49+ Safari iOS 6.1+ Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android 14+

✓ MDN

[HTMLDetailsElement](#)

Support in all current engines.

Firefox 49+ Safari 6+ Chrome 10+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 49+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 14+

Categories:

[Flow content](#).

[Sectioning root](#).

[Interactive content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [flow content](#) is expected.

Content model:

One [summary](#) element followed by [flow content](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[open](#) — Whether the details are visible

Accessibility considerations:

[For authors](#).

[For implementers](#).

DOM interface:

```
[Exposed=Window]
interface HTMLDetailsElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute boolean open;
};
```

The [**details**](#) element [represents](#) a disclosure widget from which the user can obtain additional information or controls.

The [**details**](#) element is not appropriate for footnotes. Please see [the section on footnotes](#) for details on how to mark up footnotes.

The first [**summary**](#) element child of the element, if any, [represents](#) the summary or legend of the details. If there is no child [**summary**](#) element, the user agent should provide its own legend (e.g. "Details").

The rest of the element's contents [represents](#) the additional information or controls.

The [**open**](#) content attribute is a [boolean attribute](#). If present, it indicates that both the summary and the additional information is to be shown to the user. If the attribute is absent, only the summary is to be shown.

When the element is created, if the attribute is absent, the additional information should be hidden; if the attribute is present, that information should be shown. Subsequently, if the attribute is removed, then the information should be hidden; if the attribute is added, the information should be shown.

The user agent should allow the user to request that the additional information be shown or hidden. To honor a request for the details to be shown, the user agent must [set](#) the [**open**](#) attribute on the element to the empty string. To honor a request for the information to be hidden, the user agent must [remove](#) the [**open**](#) attribute from the element.

This ability to request that additional information be shown or hidden may simply be the [activation behavior](#) of the appropriate [**summary**](#) element, in the case such an element exists. However, if no such element exists, user agents can still provide this ability through some other user interface affordance.

Whenever the [**open**](#) attribute is added to or removed from a [**details**](#) element, the user agent must [queue an element task](#) on the [DOM manipulation task source](#) given then [**details**](#) element that runs the following steps, which are known as the *details notification task steps*, for this [**details**](#) element:

1. If another [task](#) has been [queued](#) to run the [details notification task steps](#) for this [**details**](#) element, then return.

When the `open` attribute is toggled several times in succession, these steps essentially get coalesced so that only one event is fired.

2. Fire an event named `toggle` at the `details` element.

The `open` IDL attribute must reflect the `open` content attribute.

The *ancestor details revealing algorithm* is to run the following steps on `currentNode`:

1. While `currentNode` has a parent node within the flat tree:
 1. If `currentNode` is slotted into the second slot of a `details` element:
 1. Set `currentNode` to the `details` element which `currentNode` is slotted into.
 2. If the `open` attribute is not set on `currentNode`, then set the `open` attribute on `currentNode` to the empty string.
 2. Otherwise, set `currentNode` to the parent node of `currentNode` within the flat tree.

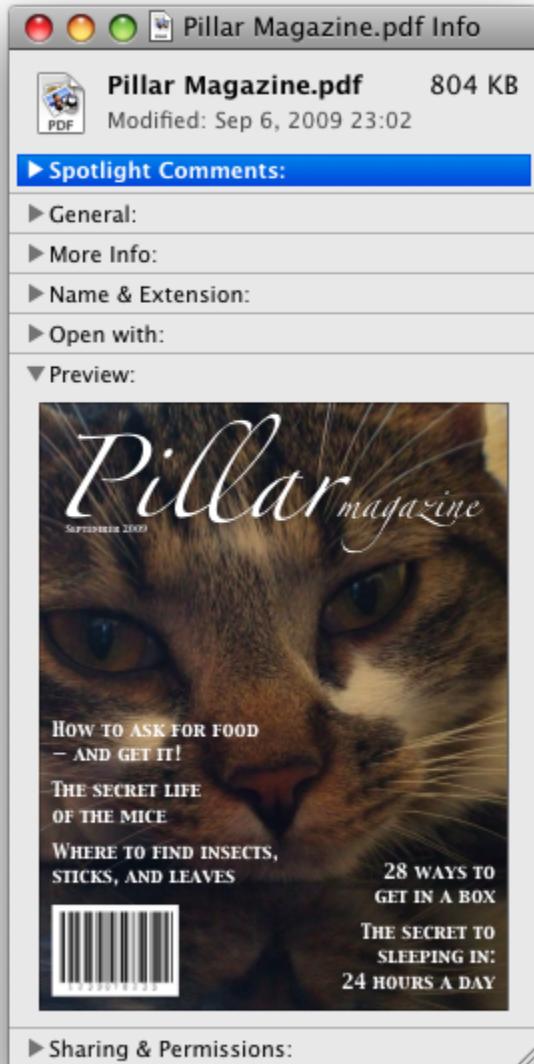
The following example shows the `details` element being used to hide technical details in a progress report.

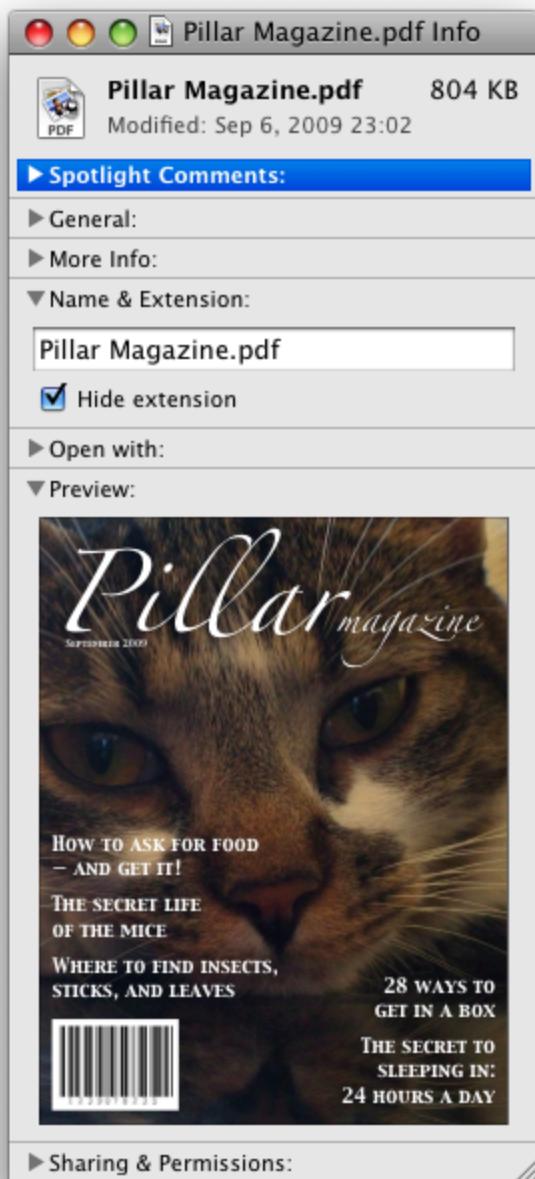
```
<section class="progress window">
  <h1>Copying "Really Achieving Your Childhood Dreams" </h1>
  <details>
    <summary>Copying... <progress max="375505392" value="97543282"></progress> </summary>
    <dl>
      <dt>Transfer rate:</dt> <dd>452KB/s</dd>
      <dt>Local filename:</dt> <dd>/home/rpausch/raycd.m4v</dd>
      <dt>Remote filename:</dt> <dd>/var/www/lectures/raycd.m4v</dd>
      <dt>Duration:</dt> <dd>01:16:27</dd>
      <dt>Color profile:</dt> <dd>SD (6-1-6)</dd>
      <dt>Dimensions:</dt> <dd>320×240</dd>
    </dl>
  </details>
</section>
```

The following shows how a `details` element can be used to hide some controls by default:

```
<details>
  <summary><label for=fn>Name & Extension:</label></summary>
  <p><input type=text id=fn name=fn value="Pillar Magazine.pdf"></p>
  <p><label><input type=checkbox name=ext checked> Hide extension</label></p>
</details>
```

One could use this in conjunction with other [details](#) in a list to allow the user to collapse a set of fields down to a small set of headings, with the ability to open each one.





In these examples, the summary really just summarizes what the controls can change, and not the actual values, which is less than ideal.

Because the [open](#) attribute is added and removed automatically as the user interacts with the control, it can be used in CSS to style the element differently based on its state. Here, a style sheet is used to animate the color of the summary when the element is opened or closed:

```
<style>
  details > summary { transition: color 1s; color: black; }
  details[open] > summary { color: red; }
</style>
```

```
<details>
  <summary>Automated Status: Operational</summary>
  <p>Velocity: 12m/s</p>
  <p>Direction: North</p>
</details>
```

4.11.2 The **summary** element



[Element/summary](#)

Support in all current engines.

Firefox 49+ Safari 6+ Chrome 12+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 49+ Safari iOS Yes Chrome Android Yes WebView Android 4+ Samsung Internet Yes Opera Android 14+

[Categories:](#)

None.

[Contexts in which this element can be used:](#)

As the [first child](#) of a [details](#) element.

[Content model:](#)

[Phrasing content](#), optionally intermixed with [heading content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

Uses [HTMLElement](#).

The [summary](#) element [represents](#) a summary, caption, or legend for the rest of the contents of the [summary](#) element's parent [details](#) element, if any.

A [summary](#) element is a *summary for its parent details* if the following algorithm returns true:

1. If this [summary](#) element has no parent, then return false.
2. Let *parent* be this [summary](#) element's parent.
3. If *parent* is not a [details](#) element, then return false.
4. If *parent*'s first [summary](#) element child is not this [summary](#) element, then return false.
5. Return true.

The [activation behavior](#) of [summary](#) elements is to run the following steps:

1. If this [summary](#) element is not the [summary for its parent details](#), then return.
2. Let *parent* be this [summary](#) element's parent.
3. If the [open](#) attribute is present on *parent*, then [remove](#) it. Otherwise, [set](#) *parent*'s [open](#) attribute to the empty string.

This will then run the [details notification task steps](#).

4.11.3 Commands

4.11.3.1 Facets

A *command* is the abstraction behind menu items, buttons, and links. Once a command is defined, other parts of the interface can refer to the same command, allowing many access points to a single feature to share facets such as the [Disabled State](#).

Commands are defined to have the following *facets*:

Label

The name of the command as seen by the user.

Access Key

A key combination selected by the user agent that triggers the command. A command might not have an Access Key.

Hidden State

Whether the command is hidden or not (basically, whether it should be shown in menus).

Disabled State

Whether the command is relevant and can be triggered or not.

Action

The actual effect that triggering the command will have. This could be a scripted event handler, a [URL](#) to which to [navigate](#), or a form submission.

User agents may expose the [commands](#) that match the following criteria:

- The [Hidden State](#) facet is false (visible)
- The element is [in a document](#) with a non-null [browsing context](#).
- Neither the element nor any of its ancestors has a [hidden](#) attribute specified.

User agents are encouraged to do this especially for commands that have [Access Keys](#), as a way to advertise those keys to the user.

For example, such commands could be listed in the user agent's menu bar.

4.11.3.2 Using the **a** element to define a command

An [a](#) element with an [href](#) attribute [defines a command](#).

The [Label](#) of the command is the element's [descendant text content](#).

The [Access Key](#) of the command is the element's [assigned access key](#), if any.

The [Hidden State](#) of the command is true (hidden) if the element has a [hidden](#) attribute, and false otherwise.

The [Disabled State](#) facet of the command is true if the element or one of its ancestors is [inert](#), and false otherwise.

The [Action](#) of the command is to [fire a click event](#) at the element.

4.11.3.3 Using the **button** element to define a command

A [button](#) element always [defines a command](#).

The [Label](#), [Access Key](#), [Hidden State](#), and [Action](#) facets of the command are determined [as for a elements](#) (see the previous section).

The [Disabled State](#) of the command is true if the element or one of its ancestors is [inert](#), or if the element's [disabled](#) state is set, and false otherwise.

4.11.3.4 Using the **input** element to define a command

An [input](#) element whose [type](#) attribute is in one of the [Submit Button](#), [Reset Button](#), [Image Button](#), [Button](#), [Radio Button](#), or [Checkbox](#) states [defines a command](#).

The [Label](#) of the command is determined as follows:

- If the [type](#) attribute is in one of the [Submit Button](#), [Reset Button](#), [Image Button](#), or [Button](#) states, then the [Label](#) is the string given by the [value](#) attribute, if any, and a UA-dependent, locale-dependent value that the UA uses to label the button itself if the

attribute is absent.

- Otherwise, if the element is a [labeled control](#), then the [Label](#) is the [descendant text content](#) of the first [label](#) element in [tree order](#) whose [labeled control](#) is the element in question. (In JavaScript terms, this is given by `element.labels[0].textContent`.)
- Otherwise, if the [value](#) attribute is present, then the [Label](#) is the value of that attribute.
- Otherwise, the [Label](#) is the empty string.

Even though the [value](#) attribute on [input](#) elements in the [Image Button](#) state is non-conformant, the attribute can still contribute to the [Label](#) determination, if it is present and the Image Button's [alt](#) attribute is missing.

The [Access Key](#) of the command is the element's [assigned access key](#), if any.

The [Hidden State](#) of the command is true (hidden) if the element has a [hidden](#) attribute, and false otherwise.

The [Disabled State](#) of the command is true if the element or one of its ancestors is [inert](#), or if the element's [disabled](#) state is set, and false otherwise.

The [Action](#) of the command is to [fire a click event](#) at the element.

4.11.3.5 Using the [option](#) element to define a command

An [option](#) element with an ancestor [select](#) element and either no [value](#) attribute or a [value](#) attribute that is not the empty string [defines a command](#).

The [Label](#) of the command is the value of the [option](#) element's [label](#) attribute, if there is one, or else the [option](#) element's [descendant text content](#), with [ASCII whitespace stripped and collapsed](#).

The [Access Key](#) of the command is the element's [assigned access key](#), if any.

The [Hidden State](#) of the command is true (hidden) if the element has a [hidden](#) attribute, and false otherwise.

The [Disabled State](#) of the command is true if the element is [disabled](#), or if its nearest ancestor [select](#) element is [disabled](#), or if it or one of its ancestors is [inert](#), and false otherwise.

If the [option](#)'s nearest ancestor [select](#) element has a [multiple](#) attribute, the [Action](#) of the command is to [toggle](#) the [option](#) element. Otherwise, the [Action](#) is to [pick](#) the [option](#) element.

4.11.3.6 Using the `accesskey` attribute on a `legend` element to define a command

A `legend` element [defines a command](#) if all of the following are true:

- It has an [assigned access key](#).
- It is a child of a `fieldset` element.
- Its parent has a descendant that [defines a command](#) that is neither a `label` element nor a `legend` element. This element, if it exists, is *the legend element's accesskey delegatee*.

The [Label](#) of the command is the element's [descendant text content](#).

The [Access Key](#) of the command is the element's [assigned access key](#).

The [Hidden State](#), [Disabled State](#), and [Action](#) facets of the command are the same as the respective facets of [the legend element's accesskey delegatee](#).

In this example, the `legend` element specifies an [accesskey](#), which, when activated, will delegate to the `input` element inside the `legend` element.

```
<fieldset>
<legend accesskey=p>
  <label>I want <input name=pizza type=number step=1 value=1 min=0>
    pizza(s) with these toppings</label>
</legend>
<label><input name=pizza-cheese type=checkbox checked> Cheese</label>
<label><input name=pizza-ham type=checkbox checked> Ham</label>
<label><input name=pizza-pineapple type=checkbox> Pineapple</label>
</fieldset>
```

4.11.3.7 Using the `accesskey` attribute to define a command on other elements

An element that has an [assigned access key](#) [defines a command](#).

If one of the earlier sections that define elements that [define commands](#) define that this element [defines a command](#), then that section applies to this element, and this section does not. Otherwise, this section applies to that element.

The [Label](#) of the command depends on the element. If the element is a [labeled control](#), the [descendant text content](#) of the first `label` element in [tree order](#) whose [labeled control](#) is the element in question is the [Label](#) (in JavaScript terms, this is given by `element.labels[0].textContent`). Otherwise, the [Label](#) is the element's [descendant text content](#).

The [Access Key](#) of the command is the element's [assigned access key](#).

The [Hidden State](#) of the command is true (hidden) if the element has a [hidden](#) attribute, and false otherwise.

The [Disabled State](#) of the command is true if the element or one of its ancestors is [inert](#), and false otherwise.

The [Action](#) of the command is to run the following steps:

1. Run the [focusing steps](#) for the element.
2. [Fire a click event](#) at the element.

4.11.4 The **dialog** element

MDN

[Element/dialog](#)

Firefox 53+ Safari No Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome Android 37+ WebView Android 37+ Samsung

Internet 3.0+ Opera Android 24+

MDN

[HTMLDialogElement](#)

Firefox 53+ Safari No Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome Android 37+ WebView Android 37+ Samsung

Internet 3.0+ Opera Android 24+

[Categories:](#)

[Flow content](#).

[Sectioning root](#).

[Contexts in which this element can be used:](#)

Where [flow content](#) is expected.

[Content model:](#)

[Flow content](#).

[Tag omission in text/html:](#)

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[**open**](#) — Whether the dialog box is showing

Accessibility considerations:

[For authors.](#)

[For implementers.](#)

DOM interface:

```
[Exposed=Window]
interface HTMLDialogElement : HTMLElement {
  HTMLConstructor constructor();

  CEReactions attribute boolean open;
  attribute DOMString returnValue;
  CEReactions undefined show();
  CEReactions undefined showModal();
  CEReactions undefined close(optional DOMString returnValue);
};
```

The [**dialog**](#) element represents a part of an application that a user interacts with to perform a task, for example a dialog box, inspector, or window.

The [**open**](#) attribute is a [boolean attribute](#). When specified, it indicates that the [**dialog**](#) element is active and that the user can interact with it.

A [**dialog**](#) element without an [**open**](#) attribute specified should not be shown to the user. This requirement may be implemented indirectly through the style layer. For example, user agents that [support the suggested default rendering](#) implement this requirement using the CSS rules described in the [Rendering section](#).

Removing the [**open**](#) attribute will usually hide the dialog. However, doing so has a number of strange additional consequences:

- The [**close**](#) event will not be fired.
- The [**close\(\)**](#) method, and any [user-agent provided cancelation interface](#), will no longer be able to close the dialog.
- If the dialog was shown using its [**showModal\(\)**](#) method, the [Document](#) will still be [blocked](#).

For these reasons, it is generally better to never remove the [**open**](#) attribute manually. Instead, use the [**close\(\)**](#) method to close the dialog, or the [**hidden**](#) attribute to hide it.

The `tabindex` attribute must not be specified on `dialog` elements.

`dialog.show()`

MDN

[HTMLDialogElement/show](#)

Firefox 53+ Safari No Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome Android 37+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

Displays the `dialog` element.

`dialog.showModal()`

MDN

[HTMLDialogElement/showModal](#)

Firefox 53+ Safari No Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome Android 37+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

Displays the `dialog` element and makes it the top-most modal dialog.

This method honors the `autofocus` attribute.

`dialog.close([result])`

MDN

[HTMLDialogElement/close](#)

Firefox 53+ Safari No Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome Android 37+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

Closes the `dialog` element.

The argument, if provided, provides a return value.

`dialog.returnValue [= result]`

MDN

[HTMLDialogElement/returnValue](#)

Firefox 53+ Safari No Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome Android 37+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

Returns the [dialog](#)'s return value.

Can be set, to update the return value.

When the `show()` method is invoked, the user agent must run the following steps:

1. If the element already has an [open](#) attribute, then return.
2. Add an [open](#) attribute to the [dialog](#) element, whose value is the empty string.
3. Set the [dialog](#) element's [previously focused element](#) to the [focused](#) element.
4. Run the [dialog focusing steps](#) for the [dialog](#) element.

When the `showModal()` method is invoked, the user agent must run the following steps:

1. Let *subject* be the [dialog](#) element on which the method was invoked.
2. If *subject* already has an [open](#) attribute, then throw an ["InvalidStateError" DOMException](#).
3. If *subject* is not [connected](#), then throw an ["InvalidStateError" DOMException](#).
4. Add an [open](#) attribute to *subject*, whose value is the empty string.
5. Set the [is modal](#) flag of *subject* to true.
6. Let *subject*'s [node document](#) be [blocked by the modal dialog](#) *subject*.

This will cause the [focused area of the document](#) to become [inert](#) (unless that currently focused area is a [shadow-including descendant](#) of *subject*). In such cases, the [focus fixup rule](#) will kick in and reset the [focused area of the document](#) to the [viewport](#) for now. In a couple steps we will attempt to find a better candidate to focus.

7. If *subject*'s [node document](#)'s [top layer](#) does not already [contain](#) *subject*, then [add](#) *subject* to *subject*'s [node document](#)'s [top layer](#).

8. Set the *subject*'s [previously focused element](#) to the [focused](#) element.
9. Run the [dialog focusing steps](#) for *subject*.

The *dialog focusing steps* for a [dialog](#) element *subject* are as follows:

1. Let *control* be the [focus delegate](#) of *subject*.
2. If *control* is null, then set *control* to *subject*.
3. Run the [focusing steps](#) for *control*.

If *control* is not [focusable](#), this will do nothing. For modal dialogs, this means that any [earlier modifications](#) to the [focused area of the document](#) will apply.

4. Let *topDocument* be the [active document](#) of *control*'s [node document](#)'s [browsing context](#)'s [top-level browsing context](#).
5. If *control*'s [node document](#)'s [origin](#) is not the [same](#) as the [origin](#) of *topDocument*, then return.
6. [Empty](#) *topDocument*'s [autofocus candidates](#).
7. Set *topDocument*'s [autofocus processed flag](#) to true.

If at any time a [dialog](#) element is [removed from a Document](#), then if that [dialog](#) is in that [Document](#)'s [top layer](#), it must be [removed](#) from it. Also, set the [dialog](#) element's [is modal](#) flag to false.

When the [close\(*returnValue*\)](#) method is invoked, the user agent must [close the dialog](#) that the method was invoked on. If *returnValue* was given, it must be used as the return value; otherwise, there is no return value.

When a [dialog](#) element *subject* is to be *closed*, optionally with a return value *result*, the user agent must run the following steps:

1. If *subject* does not have an [open](#) attribute, then return.
2. Remove *subject*'s [open](#) attribute.
3. Set the [is modal](#) flag of *subject* to false.
4. If the argument *result* was provided, then set the [returnValue](#) attribute to the value of *result*.
5. If *subject* is in its [Document](#)'s [top layer](#), then [remove](#) it.
6. If *subject*'s [previously focused element](#) is not null, then:

1. Let *element* be *subject*'s [previously focused element](#).
 2. Set *subject*'s [previously focused element](#) to null.
 3. Run the [focusing steps](#) for *element*; the viewport should not be scrolled by doing this step.
7. [Queue an element task](#) on the [user interaction task source](#) given the *subject* element to [fire an event](#) named [close](#) at *subject*.

The **returnValue** IDL attribute, on getting, must return the last value to which it was set. On setting, it must be set to the new value. When the element is created, it must be set to the empty string.

Cancelling dialogs: When [Document](#) is [blocked by a modal dialog](#) *dialog*, user agents may provide a user interface that, upon activation, [queues an element task](#) on the [user interaction task source](#) given the *dialog* element to run these steps:

1. Let *close* be the result of [firing an event](#) named [cancel](#) at *dialog*, with the [cancelable](#) attribute initialized to true.
2. If *close* is true and *dialog* has an [open](#) attribute, then [close the dialog](#) with no return value.

An example of such a UI mechanism would be the user pressing the "Escape" key.

Each [dialog](#) element has an *is modal* flag. When a [dialog](#) element is created, this flag must be set to false.

Each [dialog](#) element has a *previously focused element* which is null or an element, and it is initially null. When [showModal\(\)](#) and [show\(\)](#) are called, this element is set to the currently [focused](#) element before running the [dialog focusing steps](#).

MDN

[HTMLDialogElement/open](#)

Firefox 53+ Safari No Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome Android 37+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

The **open** IDL attribute must [reflect](#) the [open](#) content attribute.

This dialog box has some small print. The [**strong**](#) element is used to draw the user's attention to the more important part.

```
<dialog>
  <h1>Add to Wallet</h1>
  <p><strong><label for=amt>How many gold coins do you want to add to your wallet?</label></strong></p>
  <p><input id=amt name=amt type=number min=0 step=0.01 value=100></p>
  <p><small>You add coins at your own risk.</small></p>
  <p><label><input name=round type=checkbox> Only add perfectly round coins</label></p>
  <p><input type=button onclick="submit()" value="Add Coins"></p>
</dialog>
```

4.12 Scripting

Scripts allow authors to add interactivity to their documents.

Authors are encouraged to use declarative alternatives to scripting where possible, as declarative mechanisms are often more maintainable, and many users disable scripting.

For example, instead of using a script to show or hide a section to show more details, the [**details**](#) element could be used.

Authors are also encouraged to make their applications degrade gracefully in the absence of scripting support.

For example, if an author provides a link in a table header to dynamically resort the table, the link could also be made to function without scripts by requesting the sorted table from the server.

4.12.1 The **script** element



[Element/script](#)

Support in all current engines.

Firefox 1+ | Safari Yes | Chrome 1+ |

Opera Yes | Edge 79+ |

Edge (Legacy) 12+ | Internet Explorer Yes |

Firefox Android 4+ | Safari iOS Yes | Chrome Android Yes | WebView Android Yes | Samsung Internet Yes | Opera Android Yes |



[HTMLScriptElement](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Categories:

[Metadata content](#).

[Flow content](#).

[Phrasing content](#).

[Script-supporting element](#).

Contexts in which this element can be used:

Where [metadata content](#) is expected.

Where [phrasing content](#) is expected.

Where [script-supporting elements](#) are expected.

Content model:

If there is no [src](#) attribute, depends on the value of the [type](#) attribute, but must match [script content restrictions](#).

If there *is* a [src](#) attribute, the element must be either empty or contain only [script documentation](#) that also matches [script content restrictions](#).

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

[Global attributes](#)

[src](#) — Address of the resource

[type](#) — Type of script

[nomodule](#) — Prevents execution in user agents that support [module scripts](#)

[async](#) — Execute script when available, without blocking while fetching

[defer](#) — Defer script execution

[crossorigin](#) — How the element handles crossorigin requests

[integrity](#) — Integrity metadata used in *Subresource Integrity* checks [\[SRI\]](#)

[referrerpolicy](#) — Referrer policy for fetches initiated by the element

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLScriptElement : HTMLElement {
  HTMLConstructor constructor();

  [CEReactions] attribute USVString src;
  [CEReactions] attribute DOMString type;
  [CEReactions] attribute boolean noModule;
  [CEReactions] attribute boolean async;
  [CEReactions] attribute boolean defer;
  [CEReactions] attribute DOMString? crossOrigin;
  [CEReactions] attribute DOMString text;
  [CEReactions] attribute DOMString integrity;
  [CEReactions] attribute DOMString referrerPolicy;

  static boolean supports(DOMString type);

  // also has obsolete members
};
```

The [script](#) element allows authors to include dynamic script and data blocks in their documents. The element does not [represent](#) content for the user.



[Element/script#attr-type](#)

Support in all current engines.

Firefox 1+ | Safari Yes | Chrome 1+

Opera Yes | Edge 79+

Edge (Legacy) 12+ | Internet Explorer Yes

Firefox Android 4+ | Safari iOS Yes | Chrome Android Yes | WebView Android Yes | Samsung Internet Yes | Opera Android Yes

The *type* attribute allows customization of the type of script represented:

- Omitting the attribute, setting it to the empty string, or setting it to a [JavaScript MIME type essence match](#), means that the script is a [classic script](#), to be interpreted according

to the JavaScript [Script](#) top-level production. Classic scripts are affected by the [async](#) and [defer](#) attributes, but only when the [src](#) attribute is set. Authors should omit the [type](#) attribute instead of redundantly setting it.

- Setting the attribute to an [ASCII case-insensitive](#) match for the string “`module`” means that the script is a [JavaScript module script](#), to be interpreted according to the JavaScript [Module](#) top-level production. Module scripts are not affected by the [defer](#) attribute, but are affected by the [async](#) attribute (regardless of the state of the [src](#) attribute).
- Setting the attribute to any other value means that the script is a *data block*, which is not processed. None of the [script](#) attributes (except [type](#) itself) have any effect on data blocks. Authors must use a [valid MIME type string](#) that is not a [JavaScript MIME type essence match](#) to denote data blocks.

The requirement that [data blocks](#) must be denoted using a [valid MIME type string](#) is in place to avoid potential future collisions. If this specification ever adds additional types of [script](#), they will be triggered by setting the [type](#) attribute to something which is not a MIME type, like how the “`module`” value denotes [module scripts](#). By using a valid MIME type string now, you ensure that your data block will not ever be reinterpreted as a different script type, even in future user agents.

[Classic scripts](#) and [JavaScript module scripts](#) can be embedded inline, or be imported from an external file using the [src](#) attribute, which if specified gives the [URL](#) of the external script resource to use. If [src](#) is specified, it must be a [valid non-empty URL potentially surrounded by spaces](#).

The contents of inline [script](#) elements, or the external script resource, must conform with the requirements of the JavaScript specification’s [Script](#) or [Module](#) productions, for [classic scripts](#) and [JavaScript module scripts](#) respectively. [\[JAVASCRIPT\]](#)

The contents of the external script resource for [CSS module scripts](#) must conform to the requirements of the CSS specification. [\[CSS\]](#)

The contents of the external script resource for [JSON module scripts](#) must conform to the requirements of the JSON specification [\[JSON\]](#).

When used to include [data blocks](#), the data must be embedded inline, the format of the data must be given using the [type](#) attribute, and the contents of the [script](#) element must conform to the requirements defined for the format used. The [src](#), [async](#), [nomodule](#), [defer](#), [crossorigin](#), [integrity](#), and [referrerpolicy](#) attributes must not be specified.

The [nomodule](#) attribute is a [boolean attribute](#) that prevents a script from being executed in user agents that support [module scripts](#). This allows selective execution of [module scripts](#) in modern user agents and [classic scripts](#) in older user agents, [as shown below](#). The [nomodule](#) attribute must not be specified on [module scripts](#) (and will be ignored if it is).

[Element/script#attr-async](#)

Support in all current engines.

Firefox 1+ | Safari Yes | Chrome 1+ |

Opera Yes | Edge 79+ |

Edge (Legacy) 12+ | Internet Explorer Yes |

Firefox Android 4+ | Safari iOS Yes | Chrome Android Yes | WebView Android Yes | Samsung Internet Yes | Opera Android Yes |

[Element/script#attr-defer](#)

Support in all current engines.

Firefox 3.5+ | Safari Yes | Chrome Yes |

Opera Yes | Edge Yes |

Edge (Legacy) 12+ | Internet Explorer 10+ |

Firefox Android 4+ | Safari iOS Yes | Chrome Android Yes | WebView Android Yes | Samsung Internet Yes | Opera Android Yes |

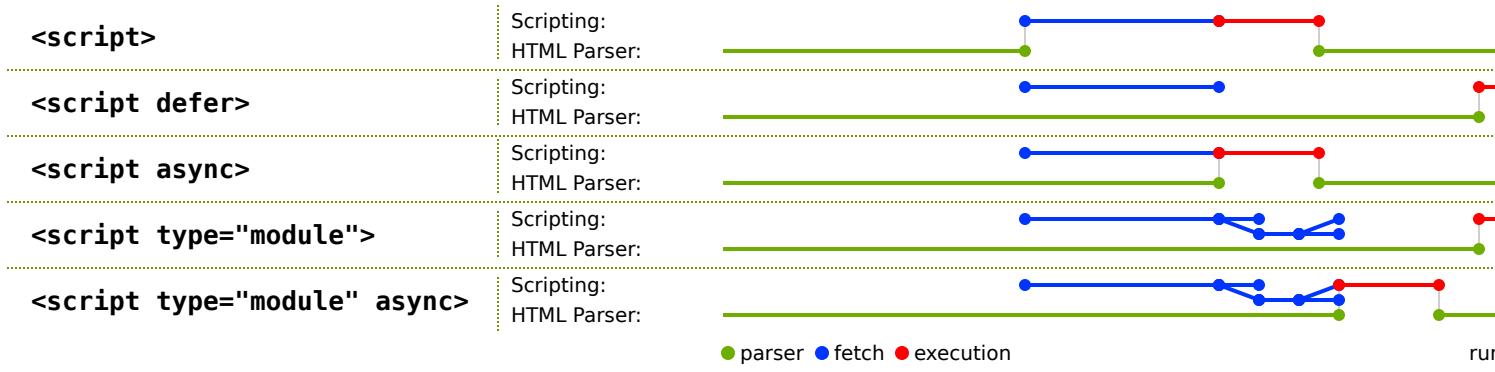
The `async` and `defer` attributes are [boolean attributes](#) that indicate how the script should be evaluated. [Classic scripts](#) may specify `defer` or `async`, but must not specify either unless the `src` attribute is present. [Module scripts](#) may specify the `async` attribute, but must not specify the `defer` attribute.

There are several possible modes that can be selected using these attributes, and depending on the script's type.

For [classic scripts](#), if the `async` attribute is present, then the classic script will be fetched [in parallel](#) to parsing and evaluated as soon as it is available (potentially before parsing completes). If the `async` attribute is not present but the `defer` attribute is present, then the classic script will be fetched [in parallel](#) and evaluated when the page has finished parsing. If neither attribute is present, then the script is fetched and evaluated immediately, blocking parsing until these are both complete.

For [module scripts](#), if the `async` attribute is present, then the module script and all its dependencies will be fetched [in parallel](#) to parsing, and the module script will be evaluated as soon as it is available (potentially before parsing completes). Otherwise, the module script and its dependencies will be fetched [in parallel](#) to parsing and evaluated when the page has finished parsing. (The `defer` attribute has no effect on module scripts.)

This is all summarized in the following schematic diagram:



The exact processing details for these attributes are, for mostly historical reasons, somewhat non-trivial, involving a number of aspects of HTML. The implementation requirements are therefore by necessity scattered throughout the specification. The algorithms below (in this section) describe the core of this processing, but these algorithms reference and are referenced by the parsing rules for [script start](#) and [end](#) tags in HTML, [in foreign content](#), and [in XML](#), the rules for the [document.write\(\)](#) method, the handling of [scripting](#), etc.

The `defer` attribute may be specified even if the `async` attribute is specified, to cause legacy web browsers that only support `defer` (and not `async`) to fall back to the `defer` behavior instead of the blocking behavior that is the default.

The `crossorigin` attribute is a [CORS settings attribute](#). For [classic scripts](#), it controls whether error information will be exposed, when the script is obtained from other [origins](#). For [module scripts](#), it controls the [credentials mode](#) used for cross-origin requests.

Unlike [classic scripts](#), [module scripts](#) require the use of the [CORS protocol](#) for cross-origin fetching.

The **integrity** attribute represents the [integrity metadata](#) for requests which this element is responsible for. The value is text. The **integrity** attribute must not be specified when the **src** attribute is not specified. [SRI]

The `referrerpolicy` attribute is a [referrer policy attribute](#). Its purpose is to set the [referrer policy](#) used when [fetching](#) the script, as well as any scripts imported from it.

[REFERRERPOLICY]

An example of a `script` element's referrer policy being used when fetching imported scripts but not other subresources:

```
<script referrerpolicy="origin">
  fetch('/api/data'); // not fetched with <script>'s referrer policy
  import('./utils.mjs'); // is fetched with <script>'s referrer policy ("origin")
</script>
```

Changing the `src`, `type`, `nomodule`, `async`, `defer`, `crossorigin`, `integrity`, and

[referrerpolicy](#) attributes dynamically has no direct effect; these attributes are only used at specific times described below.

The IDL attributes *src*, *type*, *defer*, and *integrity*, must each [reflect](#) the respective content attributes of the same name.

✓MDN

[HTMLScriptElement/referrerPolicy](#)

Support in all current engines.

Firefox65+Safari14+Chrome70+

Opera57+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android65+Safari iOS14+Chrome Android70+WebView Android70+Samsung Internet10.0+Opera Android49+

The *referrerPolicy* IDL attribute must [reflect](#) the [referrerpolicy](#) content attribute, [limited to only known values](#).

The *crossOrigin* IDL attribute must [reflect](#) the [crossorigin](#) content attribute, [limited to only known values](#).

The *noModule* IDL attribute must [reflect](#) the [nomodule](#) content attribute.

The *async* IDL attribute controls whether the element will execute asynchronously or not. If the element's "[non-blocking](#)" flag is set, then, on getting, the *async* IDL attribute must return true, and on setting, the "[non-blocking](#)" flag must first be unset, and then the content attribute must be removed if the IDL attribute's new value is false, and must be set to the empty string if the IDL attribute's new value is true. If the element's "[non-blocking](#)" flag is *not* set, the IDL attribute must [reflect](#) the [async](#) content attribute.

***script.text* [= *value*]**

Returns the [child text content](#) of the element.

Can be set, to replace the element's children with the given value.

[HTMLScriptElement.supports\(type\)](#)

Returns true if the given *type* is a script type supported by the user agent. The possible script types in this specification are "**classic**" and "**module**", but others might be added in the future.

The *text* attribute's getter must return this [script](#) element's [child text content](#).

The `text` attribute's setter must string replace all with the given value within this `script` element.

When inserted using the `document.write()` method, `script` elements usually execute (typically blocking further script execution or HTML parsing). When inserted using the `innerHTML` and `outerHTML` attributes, they do not execute at all.

MDN

[HTMLScriptElement/supports](#)

Support in one engine only.

Firefox94+SafariNoChromeNo

OperaNoEdgeNo

Edge (Legacy)NoInternet ExplorerNo

Firefox Android94+Safari iOSNoChrome AndroidNoWebView AndroidNoSamsung

InternetNoOpera AndroidNo

The `supports(type)` method steps are:

1. If `type` is "classic", then return true.
2. If `type` is "module", then return true.
3. Return false.

The `type` argument has to exactly match these values; we do not perform an ASCII case-insensitive match. This is different from how `type` content attribute values are treated, and how `DOMTokenList`'s `supports()` method works, but it aligns with the `WorkerType` enumeration used in the `Worker()` constructor.

In this example, two `script` elements are used. One embeds an external classic script, and the other includes some data as a data block.

```
<script src="game-engine.js"></script>
<script type="text/x-game-map">
    U....e
    o.....A....e
    ....A....AAA....e
    .A..AAA...AAAAA...e
</script>
```

The data in this case might be used by the script to generate the map of a video game. The data doesn't have to be used that way, though; maybe the map data is actually embedded in other parts of the page's markup, and the data block here is just used by the site's search engine to help users who are looking for particular features in their game maps.

The following sample shows how a [script](#) element can be used to define a function that is then used by other parts of the document, as part of a [classic script](#). It also shows how a [script](#) element can be used to invoke script while the document is being parsed, in this case to initialize the form's output.

```
<script>
  function calculate(form) {
    var price = 52000;
    if (form.elements.brakes.checked)
      price += 1000;
    if (form.elements.radio.checked)
      price += 2500;
    if (form.elements.turbo.checked)
      price += 5000;
    if (form.elements.sticker.checked)
      price += 250;
    form.elements.result.value = price;
  }
</script>
<form name="pricecalc" onsubmit="return false" onchange="calculate(this)">
  <fieldset>
    <legend>Work out the price of your car</legend>
    <p>Base cost: £52000.</p>
    <p>Select additional options:</p>
    <ul>
      <li><label><input type=checkbox name=brakes> Ceramic brakes (£1000)</label></li>
      <li><label><input type=checkbox name=radio> Satellite radio (£2500)</label></li>
      <li><label><input type=checkbox name=turbo> Turbo charger (£5000)</label></li>
      <li><label><input type=checkbox name=sticker> "XZ" sticker (£250)</label></li>
    </ul>
    <p>Total: £<output name=result></output></p>
  </fieldset>
  <script>
    calculate(document.forms.pricecalc);
  </script>
</form>
```

The following sample shows how a [script](#) element can be used to include an external [JavaScript module script](#).

```
<script type="module" src="app.mjs"></script>
```

This module, and all its dependencies (expressed through JavaScript `import` statements in the source file), will be fetched. Once the entire resulting module graph has been imported, and the document has finished parsing, the contents of `app.mjs` will be evaluated.

Additionally, if code from another [script](#) element in the same [Window](#) imports the module

from `app.mjs` (e.g. via `import "./app.mjs";`), then the same [JavaScript module script](#) created by the former `script` element will be imported.

This example shows how to include a [JavaScript module script](#) for modern user agents, and a [classic script](#) for older user agents:

```
<script type="module" src="app.mjs"></script>
<script nomodule defer src="classic-app-bundle.js"></script>
```

In modern user agents that support [JavaScript module scripts](#), the `script` element with the `nomodule` attribute will be ignored, and the `script` element with a `type` of "module" will be fetched and evaluated (as a [JavaScript module script](#)). Conversely, older user agents will ignore the `script` element with a `type` of "module", as that is an unknown script type for them — but they will have no problem fetching and evaluating the other `script` element (as a [classic script](#)), since they do not implement the `nomodule` attribute.

The following sample shows how a `script` element can be used to write an inline [JavaScript module script](#) that performs a number of substitutions on the document's text, in order to make for a more interesting reading experience (e.g. on a news site): [\[XKCD1288\]](#)

```
<script type="module">
  import { walkAllTextNodeDescendants } from "./dom-utils.mjs";

  const substitutions = new Map([
    ["witnesses", "these dudes I know"],
    ["allegedly", "kinda probably"],
    ["new study", "Tumblr post"],
    ["rebuild", "avenge"],
    ["space", "spaaace"],
    ["Google glass", "Virtual Boy"],
    ["smartphone", "Pokédex"],
    ["electric", "atomic"],
    ["Senator", "Elf-Lord"],
    ["car", "cat"],
    ["election", "eating contest"],
    ["Congressional leaders", "river spirits"],
    ["homeland security", "Homestar Runner"],
    ["could not be reached for comment", "is guilty and everyone knows it"]
  ]);

  function substitute(textNode) {
    for (const [before, after] of substitutions.entries()) {
      textNode.data = textNode.data.replace(new RegExp(`\\b${before}\\b`, "ig"),
    }
  }

  walkAllTextNodeDescendants(document.body, substitute);
```

```
</script>
```

Some notable features gained by using a JavaScript module script include the ability to import functions from other JavaScript modules, strict mode by default, and how top-level declarations do not introduce new properties onto the [global object](#). Also note that no matter where this [script](#) element appears in the document, it will not be evaluated until both document parsing has complete and its dependency (`dom-utils.mjs`) has been fetched and evaluated.

The following sample shows how a [JSON module script](#) can be imported from inside a [JavaScript module script](#):

```
<script type="module">
  import peopleInSpace from "http://api.open-notify.org/astros.json" assert {
    type: "json"
  }

  const list = document.querySelector("#people-in-space");
  for (const { craft, name } of peopleInSpace.people) {
    const li = document.createElement("li");
    li.textContent = `${name} / ${craft}`;
    list.append(li);
  }
</script>
```

MIME type checking for module scripts is strict. In order for the fetch of the [JSON module script](#) to succeed, the HTTP response must have a [JSON MIME type](#), for example `Content-Type: text/json`. On the other hand, if the `assert { type: "json" }` part of the statement is omitted, it is assumed that the intent is to import a [JavaScript module script](#), and the fetch will fail if the HTTP response has a MIME type that is not a [JavaScript MIME type](#).

4.12.1.1 Processing model

A [script](#) element has several associated pieces of state.

A [script](#) element has a flag indicating whether or not it has been *"already started"*. Initially, [script](#) elements must have this flag unset (script blocks, when created, are not *"already started"*). The [cloning steps](#) for [script](#) elements must set the *"already started"* flag on the copy if it is set on the element being cloned.

A [script](#) element has a *parser document*, which is either null or a [Document](#). Initially, its value must be null. It is set by the [HTML parser](#) and the [XML parser](#) on [script](#) elements they insert, and affects the processing of those elements. [script](#) elements with non-null [parser documents](#) are known as *"parser-inserted"*.

A [script](#) element has a flag indicating whether the element will be *"non-blocking"*. Initially, [script](#) elements must have this flag set. It is unset by the [HTML parser](#) and the [XML parser](#) on [script](#) elements they insert. In addition, whenever a [script](#) element whose *"non-blocking"* flag is set has an [async](#) content attribute added, the element's *"non-blocking"* flag

must be unset.

A [script](#) element has a flag indicating whether or not the script block is "ready to be parser-executed". Initially, [script](#) elements must have this flag unset (script blocks, when created, are not "ready to be parser-executed"). This flag is used only for elements that are also "[parser-inserted](#)", to let the parser know when to execute the script.

The script's type for a [script](#) element is either "classic" or "module". It is determined when the script is [prepared](#), based on the [type](#) attribute of the element at that time.

A [script](#) element has a *preparation-time document*, which is a [Document](#) determined near the beginning of the [prepare a script](#) algorithm. It is used to prevent scripts that move between documents during [preparation](#) from [executing](#).

A [script](#) element has a flag indicating whether or not the script is *from an external file*. It is determined when the script is [prepared](#), based on the [src](#) attribute of the element at that time.

The script's script for a [script](#) element is either null or a [script](#) resulting from [preparing](#) the element. This is set asynchronously after the classic script or module graph is fetched. Once it is set, either to a [script](#) in the case of success or to null in the case of failure, the fetching algorithms will note that *the script is ready*, which can trigger other actions. The user agent must [delay the load event](#) of the element's [node document](#) until [the script is ready](#).

When a [script](#) element that is not "[parser-inserted](#)" experiences one of the events listed in the following list, the user agent must [immediately prepare](#) the [script](#) element:

- The [script](#) element [becomes connected](#).
- The [script](#) element is [connected](#) and a node or document fragment is [inserted](#) into the [script](#) element, after any [script](#) elements [inserted](#) at that time.
- The [script](#) element is [connected](#) and has a [src](#) attribute set where previously the element had no such attribute.

To *prepare a script*, the user agent must act as follows:

1. If the [script](#) element is marked as having "[already started](#)", then return. The script is not executed.
2. Let *parser document* be the element's [parser document](#).
3. Set the element's [parser document](#) to null.

This is done so that if parser-inserted [script](#) elements fail to run when the parser tries to run them, e.g. because they are empty or specify an unsupported scripting language, another script can later mutate them and cause them to run again.

4. If *parser document* is non-null and the element does not have an [async](#) attribute, then

set the element's "[non-blocking](#)" flag to true.

This is done so that if a parser-inserted [script](#) element fails to run when the parser tries to run it, but it is later executed after a script dynamically updates it, it will execute in a non-blocking fashion even if the [async](#) attribute isn't set.

5. Let *source text* be the element's [child text content](#).
6. If the element has no [src](#) attribute, and *source text* is the empty string, then return. The script is not executed.
7. If the element is not [connected](#), then return. The script is not executed.
8. If either:
 - the [script](#) element has a [type](#) attribute and its value is the empty string, or
 - the [script](#) element has no [type](#) attribute but it has a [language](#) attribute and *that* attribute's value is the empty string, or
 - the [script](#) element has neither a [type](#) attribute nor a [language](#) attribute, then

...let *the script block's type string* for this [script](#) element be "text/javascript".

Otherwise, if the [script](#) element has a [type](#) attribute, let *the script block's type string* for this [script](#) element be the value of that attribute.

Otherwise, the element has a non-empty [language](#) attribute; let *the script block's type string* for this [script](#) element be the concatenation of the string "text/" followed by the value of the [language](#) attribute.

The [language](#) attribute is never conforming, and is always ignored if there is a [type](#) attribute present.

Determine [the script's type](#) as follows:

- If *the script block's type string* with [leading and trailing ASCII whitespace stripped](#) is a [JavaScript MIME type essence match](#), [the script's type](#) is "classic".
 - If *the script block's type string* is an [ASCII case-insensitive](#) match for the string "module", [the script's type](#) is "module".
 - If neither of the above conditions are true, then return. No script is executed.
9. If *parser document* is non-null, then set the element's [parser document](#) back to *parser document* and set the element's "[non-blocking](#)" flag to false.
 10. Set the element's "[already started](#)" flag.

11. Set the element's [preparation-time document](#) to its [node document](#).
12. If *parser document* is non-null, and *parser document* is not equal to the element's [preparation-time document](#), then return.
13. If [scripting is disabled](#) for the [`script`](#) element, then return. The script is not executed.

The definition of [scripting is disabled](#) means that, amongst others, the following scripts will not execute: scripts in [XMLHttpRequest](#)'s [responseXML](#) documents, scripts in [DOMParser](#)-created documents, scripts in documents created by [XSLTProcessor](#)'s [transformToDocument](#) feature, and scripts that are first inserted by a script into a [Document](#) that was created using the [createDocument\(\)](#) API. [\[XHR\]](#) [\[DOMPARSING\]](#) [\[XSLTP\]](#) [\[DOM\]](#)

14. If the [`script`](#) element has a [nomodule](#) content attribute and [the script's type](#) is "classic", then return. The script is not executed.

This means specifying [nomodule](#) on a [module script](#) has no effect; the algorithm continues onward.

15. If the [`script`](#) element does not have a [src](#) content attribute, and the [Should element's inline behavior be blocked by Content Security Policy?](#) algorithm returns "Blocked" when executed upon the [`script`](#) element, "script", and source text, then return. The script is not executed. [\[CSP\]](#)
16. If the [`script`](#) element has an [event](#) attribute and a [for](#) attribute, and [the script's type](#) is "classic", then:
 1. Let *for* be the value of the [for](#) attribute.
 2. Let *event* be the value of the [event](#) attribute.
 3. [Strip leading and trailing ASCII whitespace](#) from *event* and *for*.
 4. If *for* is not an [ASCII case-insensitive](#) match for the string "window", then return. The script is not executed.
 5. If *event* is not an [ASCII case-insensitive](#) match for either the string "onload" or the string "onload()", then return. The script is not executed.
17. If the [`script`](#) element has a [charset](#) attribute, then let *encoding* be the result of [getting an encoding](#) from the value of the [charset](#) attribute.

If the [`script`](#) element does not have a [charset](#) attribute, or if [getting an encoding](#) failed, let *encoding* be the same as [the encoding](#) of the [`script`](#) element's [node document](#).

If [the script's type](#) is "module", this encoding will be ignored.

18. Let *classic script CORS setting* be the current state of the element's [crossorigin](#) content attribute.
19. Let *module script credentials mode* be the [CORS settings attribute credentials mode](#) for the element's [crossorigin](#) content attribute.
20. Let *cryptographic nonce* be the element's [\[\[CryptographicNonce\]\]](#) internal slot's value.
21. If the [script](#) element has an [integrity](#) attribute, then let *integrity metadata* be that attribute's value.
Otherwise, let *integrity metadata* be the empty string.
22. Let *referrer policy* be the current state of the element's [referrerpolicy](#) content attribute.
23. Let *parser metadata* be "parser-inserted" if the [script](#) element is [parser-inserted](#), and "not-parser-inserted" otherwise.
24. Let *options* be a [script fetch options](#) whose [cryptographic nonce](#) is *cryptographic nonce*, [integrity metadata](#) is *integrity metadata*, [parser metadata](#) is *parser metadata*, [credentials mode](#) is *module script credentials mode*, and [referrer policy](#) is *referrer policy*.
25. Let *settings object* be the element's [node document](#)'s [relevant settings object](#).
26. If the element has a [src](#) content attribute, then:
 1. Let *src* be the value of the element's [src](#) attribute.
 2. If *src* is the empty string, [queue a task](#) to [fire an event](#) named [error](#) at the element, and return.
 3. Set the element's [from an external file](#) flag.
 4. [Parse](#) *src* relative to the element's [node document](#).
 5. If the previous step failed, [queue a task](#) to [fire an event](#) named [error](#) at the element, and return. Otherwise, let *url* be the [resulting URL record](#).
 6. Switch on [the script's type](#):

"classic"

[Fetch a classic script](#) given *url*, *settings object*, *options*, *classic script CORS setting*, and *encoding*.

"module"

[Fetch an external module script graph](#) given *url*, *settings object*, and *options*.

When the chosen algorithm asynchronously completes, set [the script's script](#) to the result. At that time, [the script is ready](#).

For performance reasons, user agents may start fetching the classic script or module graph (as defined above) as soon as the [src](#) attribute is set, instead, in the hope that the element will be inserted into the document (and that the [crossorigin](#) attribute won't change value in the meantime). Either way, once the element is [inserted into the document](#), the load must have started as described in this step. If the UA performs such prefetching, but the element is never inserted in the document, or the [src](#) attribute is dynamically changed, or the [crossorigin](#) attribute is dynamically changed, then the user agent will not execute the script so obtained, and the fetching process will have been effectively wasted.

27. If the element does not have a [src](#) content attribute, run these substeps:

1. Let *base URL* be the [script](#) element's [node document's document base URL](#).
2. Switch on [the script's type](#):

"classic"

1. Let *script* be the result of [creating a classic script](#) using *source text*, *settings object*, *base URL*, and *options*.
2. Set [the script's script](#) to *script*.
3. [The script is ready](#).

"module"

1. [Fetch an inline module script graph](#), given *source text*, *base URL*, *settings object*, and *options*. When this asynchronously completes, set [the script's script](#) to the result. At that time, [the script is ready](#).

28. Then, follow the first of the following options that describes the situation:

If [the script's type](#) is "**classic**", and the element has a [src](#) attribute, and the element has a [defer](#) attribute, and the element is [parser-inserted](#), and the element does not have an [async](#) attribute

If [the script's type](#) is "**module**", and the element is [parser-inserted](#), and the element does not have an [async](#) attribute

Add the element to the end of the *list of scripts that will execute when the document has finished parsing* associated with the [Document](#) of the parser that created the element.

When [the script is ready](#), set the element's ["ready to be parser-executed"](#) flag. The parser will handle executing the script.

If [the script's type](#) is "**classic**", and the element has a [src](#) attribute, and the element is [parser-inserted](#), and the element does not have an [async](#) attribute

The element is the [pending parsing-blocking script](#) of the [Document](#) of the parser that created the element. (There can only be one such script per [Document](#) at a time.)

When [the script is ready](#), set the element's ["ready to be parser-executed"](#) flag. The parser will handle executing the script.

If [the script's type](#) is "**classic**", and the element has a [src](#) attribute, and the element does not have an [async](#) attribute, and the element does not have the ["non-blocking"](#) flag set

If [the script's type](#) is "**module**", and the element does not have an [async](#) attribute, and the element does not have the ["non-blocking"](#) flag set

Add the element to the end of the *list of scripts that will execute in order as soon as possible* associated with the element's [preparation-time document](#).

When [the script is ready](#), run the following steps:

1. If the element is not now the first element in the [list of scripts that will execute in order as soon as possible](#) to which it was added above, then mark the element as ready but return without executing the script yet.
2. *Execution*: [Execute the script block](#) corresponding to the first script element in this [list of scripts that will execute in order as soon as possible](#).
3. Remove the first element from this [list of scripts that will execute in order as soon as possible](#).
4. If this [list of scripts that will execute in order as soon as possible](#) is still not empty and the first entry has already been marked as ready, then jump back to the step labeled *execution*.

If [the script's type](#) is "**classic**", and the element has a [src](#) attribute

If [the script's type](#) is "**module**"

The element must be added to the *set of scripts that will execute as soon as possible* of the element's [preparation-time document](#).

When [the script is ready](#), [execute the script block](#) and then remove the element from the [set of scripts that will execute as soon as possible](#).

If the element does not have a [src](#) attribute, and the element is "[parser-inserted](#)", and either the parser that created the [script](#) is an [XML parser](#) or it's an [HTML parser](#) whose [script nesting level](#) is not greater than one, and the element's [parser document has a style sheet that is blocking scripts](#)

The element is the [pending parsing-blocking script](#) of its [parser document](#). (There can only be one such script per [Document](#) at a time.)

Set the element's "[ready to be parser-executed](#)" flag. The parser will handle executing the script.

Otherwise

[Immediately execute the script block](#), even if other scripts are already executing.

The [pending parsing-blocking script](#) of a [Document](#) is used by the [Document](#)'s parser(s).

If a [script](#) element that blocks a parser gets moved to another [Document](#) before it would normally have stopped blocking that parser, it nonetheless continues blocking that parser until the condition that causes it to be blocking the parser no longer applies (e.g., if the script is a [pending parsing-blocking script](#) because the original [Document has a style sheet that is blocking scripts](#) when it was parsed, but then the script is moved to another [Document](#) before the blocking style sheet(s) loaded, the script still blocks the parser until the style sheets are all loaded, at which time the script executes and the parser is unblocked).

To [execute a script block](#) given a [script](#) element *scriptElement*:

1. Let *document* be *scriptElement*'s [node document](#).
2. If *scriptElement*'s [preparation-time document](#) is not equal to *document*, then return.
3. If [the script's script](#) is null for *scriptElement*, then [fire an event](#) named [error](#) at *scriptElement*, and return.
4. If *scriptElement* is [from an external file](#), or [the script's type](#) for *scriptElement* is "**module**", then increment *document*'s [ignore-destructive-writes counter](#).
5. Switch on [the script's type](#) for *scriptElement*:

"classic"

1. Let *oldCurrentScript* be the value to which *document*'s [**currentScript**](#) object was most recently set.
2. If *scriptElement*'s [**root**](#) is not a [shadow root](#), then set *document*'s [**currentScript**](#) attribute to *scriptElement*. Otherwise, set it to null.

This does not use the [in a document tree](#) check, as *scriptElement* could have been removed from the document prior to execution, and in that scenario [**currentScript**](#) still needs to point to it.

3. [Run the classic script](#) given by [the script's script](#) for *scriptElement*.
4. Set *document*'s [**currentScript**](#) attribute to *oldCurrentScript*.

"module"

1. Assert: *document*'s [**currentScript**](#) attribute is null.
2. [Run the module script](#) given by [the script's script](#) for *scriptElement*.
6. Decrement the [ignore-destructive-writes counter](#) of *document*, if it was incremented in the earlier step.
7. If *scriptElement* is [from an external file](#), then [fire an event](#) named [**load**](#) at *scriptElement*.

4.12.1.2 Scripting languages

User agents are not required to support JavaScript. This standard needs to be updated if a language other than JavaScript comes along and gets similar wide adoption by web browsers. Until such a time, implementing other languages is in conflict with this standard, given the processing model defined for the [**script**](#) element.

Servers should use [**text/javascript**](#) for JavaScript resources. Servers should not use other [JavaScript MIME types](#) for JavaScript resources, and must not use non-[JavaScript MIME types](#).

For external JavaScript resources, MIME type parameters in '[**Content-Type**](#)' headers are generally ignored. (In some cases the '[**charset**](#)' parameter has an effect.) However, for the [**script**](#) element's [**type**](#) attribute they are significant; it uses the [JavaScript MIME type essence match](#) concept.

For example, scripts with their [**type**](#) attribute set to "[**text/javascript; charset=utf-8**](#)" will not be evaluated, even though that is a valid [JavaScript MIME type](#) when parsed.

Furthermore, again for external JavaScript resources, special considerations apply around

'Content-Type' header processing as detailed in the [prepare a script](#) algorithm and *Fetch*.
[FETCH]

4.12.1.3 Restrictions for contents of **script** elements

The easiest and safest way to avoid the rather strange restrictions described in this section is to always escape an ASCII case-insensitive match for "<!--" as "\x3C!--", "<script" as "\x3Cscript", and "</script" as "\x3C/script" when these sequences appear in literals in scripts (e.g. in strings, regular expressions, or comments), and to avoid writing code that uses such constructs in expressions. Doing so avoids the pitfalls that the restrictions in this section are prone to triggering: namely, that, for historical reasons, parsing of **script** blocks in HTML is a strange and exotic practice that acts unintuitively in the face of these sequences.

The **script** element's [descendant text content](#) must match the **script** production in the following ABNF, the character set for which is Unicode. [\[ABNF\]](#)

```
script      = outer *( comment-open inner comment-close outer )

outer       = < any string that doesn't contain a substring that matches no
not-in-outer = comment-open
inner       = < any string that doesn't contain a substring that matches no
not-in-inner = comment-close / script-open

comment-open = "<!--"
comment-close = "-->"
script-open   = "<" s c r i p t tag-end

s           = %x0053 ; U+0053 LATIN CAPITAL LETTER S
s           =/%x0073 ; U+0073 LATIN SMALL LETTER S
c           = %x0043 ; U+0043 LATIN CAPITAL LETTER C
c           =/%x0063 ; U+0063 LATIN SMALL LETTER C
r           = %x0052 ; U+0052 LATIN CAPITAL LETTER R
r           =/%x0072 ; U+0072 LATIN SMALL LETTER R
i           = %x0049 ; U+0049 LATIN CAPITAL LETTER I
i           =/%x0069 ; U+0069 LATIN SMALL LETTER I
p           = %x0050 ; U+0050 LATIN CAPITAL LETTER P
p           =/%x0070 ; U+0070 LATIN SMALL LETTER P
t           = %x0054 ; U+0054 LATIN CAPITAL LETTER T
t           =/%x0074 ; U+0074 LATIN SMALL LETTER T

tag-end     = %x0009 ; U+0009 CHARACTER TABULATION (tab)
tag-end     =/%x000A ; U+000A LINE FEED (LF)
tag-end     =/%x000C ; U+000C FORM FEED (FF)
tag-end     =/%x0020 ; U+0020 SPACE
tag-end     =/%x002F ; U+002F SOLIDUS (/)
tag-end     =/%x003E ; U+003E GREATER-THAN SIGN (>)
```

When a `script` element contains [script documentation](#), there are further restrictions on the contents of the element, as described in the section below.

The following script illustrates this issue. Suppose you have a script that contains a string, as in:

```
const example = 'Consider this string: <!-- <script>';
console.log(example);
```

If one were to put this string directly in a `script` block, it would violate the restrictions above:

```
<script>
  const example = 'Consider this string: <!-- <script>';
  console.log(example);
</script>
```

The bigger problem, though, and the reason why it would violate those restrictions, is that actually the script would get parsed weirdly: *the script block above is not terminated*. That is, what looks like a "`</script>`" end tag in this snippet is actually still part of the `script` block. The script doesn't execute (since it's not terminated); if it somehow were to execute, as it might if the markup looked as follows, it would fail because the script (highlighted here) is not valid JavaScript:

```
<script>
  const example = 'Consider this string: <!-- <script>';
  console.log(example);
</script>
<!-- despite appearances, this is actually part of the script still! -->
<script>
  ... // this is the same script block still...
</script>
```

What is going on here is that for legacy reasons, "`<!--`" and "`<script`" strings in `script` elements in HTML need to be balanced in order for the parser to consider closing the block.

By escaping the problematic strings as mentioned at the top of this section, the problem is avoided entirely:

```
<script>
  // Note: `<x3C` is an escape sequence for `<`.
  const example = 'Consider this string: <x3C!-- <x3Cscript>';
  console.log(example);
</script>
<!-- this is just a comment between script blocks -->
<script>
  ... // this is a new script block
</script>
```

It is possible for these sequences to naturally occur in script expressions, as in the following examples:

```
if (x<!--y) { ... }
if ( player<script ) { ... }
```

In such cases the characters cannot be escaped, but the expressions can be rewritten so that the sequences don't occur, as in:

```
if (x < !--y) { ... }
if (!--y > x) { ... }
if (!(--y) > x) { ... }
if (player < script) { ... }
if (script > player) { ... }
```

Doing this also avoids a different pitfall as well: for related historical reasons, the string "<!--" in [classic scripts](#) is actually treated as a line comment start, just like "//".

4.12.1.4 *Inline documentation for external scripts*

If a [**script**](#) element's [**src**](#) attribute is specified, then the contents of the [**script**](#) element, if any, must be such that the value of the [**text**](#) IDL attribute, which is derived from the element's contents, matches the [**documentation**](#) production in the following ABNF, the character set for which is Unicode. [\[ABNF\]](#)

```
documentation = *( *( space / tab / comment ) [ line-comment ] newline )
comment       = slash star *( not-star / star not-slash ) 1*star slash
line-comment   = slash slash *not-newline

; characters
tab           = %x0009 ; U+0009 CHARACTER TABULATION (tab)
newline        = %x000A ; U+000A LINE FEED (LF)
space          = %x0020 ; U+0020 SPACE
star           = %x002A ; U+002A ASTERISK (*)
slash          = %x002F ; U+002F SOLIDUS (/)
not-newline    = %x0000-0009 / %x000B-10FFFF
                  ; a scalar value other than U+000A LINE FEED (LF)
not-star       = %x0000-0029 / %x002B-10FFFF
                  ; a scalar value other than U+002A ASTERISK (*)
not-slash      = %x0000-002E / %x0030-10FFFF
                  ; a scalar value other than U+002F SOLIDUS (/)
```

This corresponds to putting the contents of the element in JavaScript comments.

This requirement is in addition to the earlier restrictions on the syntax of contents of [**script**](#) elements.

This allows authors to include documentation, such as license information or API information, inside their documents while still referring to external script files. The syntax is constrained so that authors don't accidentally include what looks like valid script while also providing a [src](#) attribute.

```
<script src="cool-effects.js">
  // create new instances using:
  //   var e = new Effect();
  // start the effect using .play, stop using .stop:
  //   e.play();
  //   e.stop();
</script>
```

4.12.1.5 Interaction of [script](#) elements and XSLT

This section is non-normative.

This specification does not define how XSLT interacts with the [script](#) element. However, in the absence of another specification actually defining this, here are some guidelines for implementers, based on existing implementations:

- When an XSLT transformation program is triggered by an `<?xml-stylesheet?>` processing instruction and the browser implements a direct-to-DOM transformation, [script](#) elements created by the XSLT processor need to have its [parser document](#) set correctly, and run in document order (modulo scripts marked [defer](#) or [async](#)), [immediately](#), as the transformation is occurring.
- The [XSLTProcessor transformToDocument\(\)](#) method adds elements to a [Document](#) object with a null [browsing context](#), and, accordingly, any [script](#) elements they create need to have their "[already started](#)" flag set in the [prepare a script](#) algorithm and never get executed ([scripting is disabled](#)). Such [script](#) elements still need to have their [parser document](#) set, though, such that their [async](#) IDL attribute will return false in the absence of an [async](#) content attribute.
- The [XSLTProcessor transformToFragment\(\)](#) method needs to create a fragment that is equivalent to one built manually by creating the elements using [document.createElementNS\(\)](#). For instance, it needs to create [script](#) elements with null [parser document](#) and that don't have their "[already started](#)" flag set, so that they will execute when the fragment is inserted into a document.

The main distinction between the first two cases and the last case is that the first two operate on [Document](#)s and the last operates on a fragment.

4.12.2 The **noscript** element

[Element/noscript](#)

Support in all current engines.

Firefox 1+ Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

[Categories:](#)

[Metadata content](#).

[Flow content](#).

[Phrasing content](#).

[Contexts in which this element can be used:](#)

In a [head](#) element of an [HTML document](#), if there are no ancestor [noscript](#) elements.

Where [phrasing content](#) is expected in [HTML documents](#), if there are no ancestor [noscript](#) elements.

[Content model:](#)

When [scripting is disabled](#), in a [head](#) element: in any order, zero or more [link](#) elements, zero or more [style](#) elements, and zero or more [meta](#) elements.

When [scripting is disabled](#), not in a [head](#) element: [transparent](#), but there must be no [noscript](#) element descendants.

Otherwise: text that conforms to the requirements given in the prose.

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors](#).

[For implementers](#).

[DOM interface:](#)

Uses [HTMLElement](#).

The [noscript](#) element [represents](#) nothing if [scripting is enabled](#), and [represents](#) its children if [scripting is disabled](#). It is used to present different markup to user agents that support scripting and those that don't support scripting, by affecting how the document is parsed.

When used in [HTML documents](#), the allowed content model is as follows:

In a [**head**](#) element, if [scripting is disabled](#) for the [**noscript**](#) element

The [**noscript**](#) element must contain only [**link**](#), [**style**](#), and [**meta**](#) elements.

In a [**head**](#) element, if [scripting is enabled](#) for the [**noscript**](#) element

The [**noscript**](#) element must contain only text, except that invoking the [HTML fragment parsing algorithm](#) with the [**noscript**](#) element as the [**context**](#) element and the text contents as the *input* must result in a list of nodes that consists only of [**link**](#), [**style**](#), and [**meta**](#) elements that would be conforming if they were children of the [**noscript**](#) element, and no [parse errors](#).

Outside of [**head**](#) elements, if [scripting is disabled](#) for the [**noscript**](#) element

The [**noscript**](#) element's content model is [transparent](#), with the additional restriction that a [**noscript**](#) element must not have a [**noscript**](#) element as an ancestor (that is, [**noscript**](#) can't be nested).

Outside of [**head**](#) elements, if [scripting is enabled](#) for the [**noscript**](#) element

The [**noscript**](#) element must contain only text, except that the text must be such that running the following algorithm results in a conforming document with no [**noscript**](#) elements and no [**script**](#) elements, and such that no step in the algorithm throws an exception or causes an [HTML parser](#) to flag a [parse error](#):

1. Remove every [**script**](#) element from the document.
2. Make a list of every [**noscript**](#) element in the document. For every [**noscript**](#) element in that list, perform the following steps:
 1. Let *s* be the [**child text content**](#) of the [**noscript**](#) element.
 2. Set the [**outerHTML**](#) attribute of the [**noscript**](#) element to the value of *s*. (This, as a side-effect, causes the [**noscript**](#) element to be removed from the document.) [DOMPARSING](#)

All these contortions are required because, for historical reasons, the [**noscript**](#) element is handled differently by the [HTML parser](#) based on whether [scripting was enabled or not](#) when the parser was invoked.

The [**noscript**](#) element must not be used in [XML documents](#).

The [**noscript**](#) element is only effective in [the HTML syntax](#), it has no effect in [the XML syntax](#). This is because the way it works is by essentially "turning off" the parser when scripts are enabled, so that the contents of the element are treated as pure text and not as real elements. XML does not define a mechanism by which to do this.

The [**noscript**](#) element has no other requirements. In particular, children of the [**noscript**](#)

element are not exempt from [form submission](#), scripting, and so forth, even when [scripting is enabled](#) for the element.

In the following example, a [**noscript**](#) element is used to provide fallback for a script.

```
<form action="calcSquare.php">
<p>
  <label for=x>Number</label>:
  <input id="x" name="x" type="number">
</p>
<script>
  var x = document.getElementById('x');
  var output = document.createElement('p');
  output.textContent = 'Type a number; it will be squared right then!';
  x.form.appendChild(output);
  x.form.onsubmit = function () { return false; }
  x.oninput = function () {
    var v = x.valueAsNumber;
    output.textContent = v + ' squared is ' + v * v;
  };
</script>
<noscript>
  <input type=submit value="Calculate Square">
</noscript>
</form>
```

When script is disabled, a button appears to do the calculation on the server side. When script is enabled, the value is computed on-the-fly instead.

The [**noscript**](#) element is a blunt instrument. Sometimes, scripts might be enabled, but for some reason the page's script might fail. For this reason, it's generally better to avoid using [**noscript**](#), and to instead design the script to change the page from being a scriptless page to a scripted page on the fly, as in the next example:

```
<form action="calcSquare.php">
<p>
  <label for=x>Number</label>:
  <input id="x" name="x" type="number">
</p>
<input id="submit" type=submit value="Calculate Square">
<script>
  var x = document.getElementById('x');
  var output = document.createElement('p');
  output.textContent = 'Type a number; it will be squared right then!';
  x.form.appendChild(output);
  x.form.onsubmit = function () { return false; }
  x.oninput = function () {
```

```
var v = x.valueAsNumber;
output.textContent = v + ' squared is ' + v * v;
};

var submit = document.getElementById('submit');
submit.parentNode.removeChild(submit);
</script>
</form>
```

The above technique is also useful in [XML documents](#), since `noscript` is not allowed there.

4.12.3 The `template` element



[Element/template](#)

Support in all current engines.

Firefox 22+ Safari 8+ Chrome 26+

Opera 15+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 22+ Safari iOS 8+ Chrome Android 26+ WebView Android Yes Samsung Internet 1.5+ Opera Android?



[HTMLTemplateElement](#)

Support in all current engines.

Firefox 22+ Safari 8+ Chrome 26+

Opera 15+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 22+ Safari iOS 8+ Chrome Android 26+ WebView Android 37+ Samsung Internet 1.5+ Opera Android Yes

Categories:

[Metadata content](#).

[Flow content](#).

[Phrasing content](#).

[Script-supporting element](#).

Contexts in which this element can be used:

Where [metadata content](#) is expected.

Where [phrasing content](#) is expected.

Where [script-supporting elements](#) are expected.

As a child of a [colgroup](#) element that doesn't have a [span](#) attribute.

[Content model:](#)

[Nothing](#) (for clarification, [see example](#)).

[Tag omission in text/html:](#)

Neither tag is omissible.

[Content attributes:](#)

[Global attributes](#)

[Accessibility considerations:](#)

[For authors.](#)

[For implementers.](#)

[DOM interface:](#)

```
[Exposed=Window]
interface HTMLOptionsCollection : HTMLElement {
  [HTMLConstructor] constructor();
  readonly attribute DocumentFragment content;
};
```

The [template](#) element is used to declare fragments of HTML that can be cloned and inserted in the document by script.

In a rendering, the [template](#) element [represents](#) nothing.

The [template contents](#) of a [template](#) element [are not children of the element itself](#).

It is also possible, as a result of DOM manipulation, for a [template](#) element to contain [Text](#) nodes and element nodes; however, having any is a violation of the [template](#) element's content model, since its content model is defined as [nothing](#).

For example, consider the following document:

```
<!doctype html>
<html lang="en">
  <head>
    <title>Homework</title>
  <body>
    <template id="template"><p>Smile!</p></template>
    <script>
```

```
let num = 3;
const fragment = document.getElementById('template').content.cloneNode(true);
while (num-- > 1) {
    fragment.firstChild.before(fragment.firstChild.cloneNode(true));
    fragment.firstChild.textContent += fragment.lastChild.textContent;
}
document.body.appendChild(fragment);
</script>
</html>
```

The `p` element in the `template` is *not* a child of the `template` in the DOM; it is a child of the `DocumentFragment` returned by the `template` element's `content` IDL attribute.

If the script were to call `appendChild()` on the `template` element, that would add a child to the `template` element (as for any other element); however, doing so is a violation of the `template` element's content model.

`template.content`



[HTMLTemplateElement/content](#)

Support in all current engines.

Firefox 22+ Safari 8+ Chrome 26+

Opera 15+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 22+ Safari iOS 8+ Chrome Android 26+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android Yes

Returns the `template contents` (a `DocumentFragment`).

Each `template` element has an associated `DocumentFragment` object that is its *template contents*. The `template contents` have [no conformance requirements](#). When a `template` element is created, the user agent must run the following steps to establish the `template contents`:

1. Let `doc` be the `template` element's [node document](#)'s [appropriate template contents owner document](#).
2. Create a `DocumentFragment` object whose [node document](#) is `doc` and [host](#) is the `template` element.
3. Set the `template` element's `template contents` to the newly created `DocumentFragment` object.

A [Document](#) *doc*'s appropriate template contents owner document is the [Document](#) returned by the following algorithm:

1. If *doc* is not a [Document](#) created by this algorithm, then:
 1. If *doc* does not yet have an [associated inert template document](#), then:
 1. Let *new doc* be a new [Document](#) (whose [browsing context](#) is null). This is "a [Document](#) created by this algorithm" for the purposes of the step above.
 2. If *doc* is an [HTML document](#), mark *new doc* as an [HTML document](#) also.
 3. Let *doc*'s [associated inert template document](#) be *new doc*.
 2. Set *doc* to *doc*'s [associated inert template document](#).

Each [Document](#) not created by this algorithm thus gets a single [Document](#) to act as its proxy for owning the [template contents](#) of all its [template](#) elements, so that they aren't in a [browsing context](#) and thus remain inert (e.g. scripts do not run). Meanwhile, [template](#) elements inside [Document](#) objects that are created by this algorithm just reuse the same [Document](#) owner for their contents.

2. Return *doc*.

The [adopting steps](#) (with *node* and *oldDocument* as parameters) for [template](#) elements are the following:

1. Let *doc* be *node*'s [node document](#)'s [appropriate template contents owner document](#).
node's [node document](#) is the [Document](#) object that *node* was just adopted *into*.
2. [Adopt](#) *node*'s [template contents](#) (a [DocumentFragment](#) object) into *doc*.

The [content](#) IDL attribute must return the [template](#) element's [template contents](#).

The [cloning steps](#) for a [template](#) element *node* being cloned to a copy *copy* must run the following steps:

1. If the *clone children flag* is not set in the calling [clone](#) algorithm, return.
2. Let *copied contents* be the result of [cloning](#) all the children of *node*'s [template contents](#), with *document* set to *copy*'s [template contents](#)'s [node document](#), and with the *clone children flag* set.
3. Append *copied contents* to *copy*'s [template contents](#).

In this example, a script populates a table four-column with data from a data structure, using a [template](#) to provide the element structure instead of manually generating the structure from markup.

```
<!DOCTYPE html>
<html lang='en'>
<title>Cat data</title>
<script>
  // Data is hard-coded here, but could come from the server
  var data = [
    { name: 'Pillar', color: 'Ticked Tabby', sex: 'Female (neutered)', legs: 3 },
    { name: 'Hederal', color: 'Tuxedo', sex: 'Male (neutered)', legs: 4 },
  ];
</script>
<table>
  <thead>
    <tr>
      <th>Name <th>Color <th>Sex <th>Legs
  <tbody>
    <template id="row">
      <tr><td><td><td><td>
    </template>
</table>
<script>
  var template = document.querySelector('#row');
  for (var i = 0; i < data.length; i += 1) {
    var cat = data[i];
    var clone = template.content.cloneNode(true);
    var cells = clone.querySelectorAll('td');
    cells[0].textContent = cat.name;
    cells[1].textContent = cat.color;
    cells[2].textContent = cat.sex;
    cells[3].textContent = cat.legs;
    template.parentNode.appendChild(clone);
  }
</script>
```

This example uses [cloneNode\(\)](#) on the [template](#)'s contents; it could equivalently have used [document.importNode\(\)](#), which does the same thing. The only difference between these two APIs is when the [node document](#) is updated: with [cloneNode\(\)](#) it is updated when the nodes are appended with [appendChild\(\)](#), with [document.importNode\(\)](#) it is updated when the nodes are cloned.

4.12.3.1 Interaction of [template](#) elements with XSLT and XPath

This section is non-normative.

This specification does not define how XSLT and XPath interact with the [template](#) element. However, in the absence of another specification actually defining this, here are some guidelines for implementers, which are intended to be consistent with other processing described in this specification:

- An XSLT processor based on an XML parser that acts [as described in this specification](#) needs to act as if [template](#) elements contain as descendants their [template contents](#) for the purposes of the transform.
- An XSLT processor that outputs a DOM needs to ensure that nodes that would go into a [template](#) element are instead placed into the element's [template contents](#).
- XPath evaluation using the XPath DOM API when applied to a [Document](#) parsed using the [HTML parser](#) or the [XML parser](#) described in this specification needs to ignore [template contents](#).

4.12.4 The **slot** element



[Element\[slot\]](#)

Support in all current engines.

Firefox 63+ Safari 10+ Chrome 53+

Opera 40+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 63+ Safari iOS 10+ Chrome Android 53+ WebView Android 53+ Samsung Internet 6.0+ Opera Android 41+



[HTMLSlotElement](#)

Support in all current engines.

Firefox 63+ Safari 10+ Chrome 53+

Opera 40+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 63+ Safari iOS 10+ Chrome Android 53+ WebView Android 53+ Samsung Internet 6.0+ Opera Android 41+

[Categories:](#)

[Flow content](#).

[Phrasing content](#).

Contexts in which this element can be used:

Where phrasing content is expected.

Content model:

Transparent

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

name — Name of shadow tree slot

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
[Exposed=Window]
interface HTMLSlotElement : HTMLElement {
  [HTMLConstructor] constructor();

  [CEReactions] attribute DOMString name;
  sequence<Node> assignedNodes(optional AssignedNodesOptions options = {});
  sequence<Element> assignedElements(optional AssignedNodesOptions options
    undefined assign((Element or Text)... nodes);
};

dictionary AssignedNodesOptions {
  boolean flatten = false;
};
```

The slot element defines a slot. It is typically used in a shadow tree. A slot element represents its assigned nodes, if any, and its contents otherwise.

The name content attribute may contain any string value. It represents a slot's name.

The name attribute is used to assign slots to other elements: a slot element with a name attribute creates a named slot to which any element is assigned if that element has a slot attribute whose value matches that name attribute's value, and the slot element is a child of the shadow tree whose root's host has that corresponding slot attribute value.

slot.name

✓MDN

[HTMLSlotElement/name](#)

Support in all current engines.

Firefox63+Safari10+Chrome53+

Opera40+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS10+Chrome Android53+WebView Android53+Samsung Internet6.0+Opera Android41+

Can be used to get and set slot's [name](#).

[slot.assignedNodes\(\)](#)



[HTMLSlotElement/assignedNodes](#)

Support in all current engines.

Firefox63+Safari10+Chrome53+

Opera40+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS10+Chrome Android53+WebView Android53+Samsung Internet6.0+Opera Android41+

Returns slot's [assigned nodes](#).

[slot.assignedNodes\({ flatten: true }\)](#)

Returns slot's [assigned nodes](#), if any, and slot's children otherwise, and does the same for any [slot](#) elements encountered therein, recursively, until there are no [slot](#) elements left.

[slot.assignedElements\(\)](#)



[HTMLSlotElement/assignedElements](#)

Support in all current engines.

Firefox66+Safari12.1+Chrome65+

Opera52+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android66+Safari iOS12.2+Chrome Android65+WebView Android65+Samsung Internet9.0+Opera Android47+

Returns slot's [assigned nodes](#), limited to elements.

[slot.assignedElements\({ flatten: true }\)](#)

Returns the same as [assignedNodes\({ flatten: true }\)](#), limited to elements.

`slot.assign(...nodes)`

Sets `slot`'s [manually assigned nodes](#) to the given `nodes`.

The `name` IDL attribute must [reflect](#) the content attribute of the same name.

The `slot` element has *manually assigned nodes*, which is an [ordered set](#) of [slottables](#) set by [`assign\(\)`](#). This set is initially empty.

The [manually assigned nodes](#) set can be implemented using weak references to the [slottables](#), because this set is not directly accessible from script.

The `assignedNodes(options)` method steps are:

1. If `options["flatten"]` is false, then return [this's assigned nodes](#).
2. Return the result of [finding flattened slottables](#) with [this](#).

The `assignedElements(options)` method steps are:

1. If `options["flatten"]` is false, then return [this's assigned nodes](#), filtered to contain only [Element](#) nodes.
2. Return the result of [finding flattened slottables](#) with [this](#), filtered to contain only [Element](#) nodes.

MDN

[HTMLSlotElement/assign](#)

Firefox 92+ Safari No Chrome 86+

Opera 72+ Edge 86+

Edge (Legacy) No Internet Explorer No

Firefox Android 92+ Safari iOS No Chrome Android 86+ WebView Android 86+ Samsung Internet 14.0+ Opera Android 61+

The `assign(...nodes)` method steps are:

1. [For each](#) `node` of [this's manually assigned nodes](#), set `node`'s [manual slot assignment](#) to null.
2. Let `nodesSet` be a new [ordered set](#).
3. [For each](#) `node` of `nodes`:
 1. If `node`'s [manual slot assignment](#) refers to a [slot](#), then remove `node` from that [slot](#)'s [manually assigned nodes](#).

2. Set *node*'s [manual slot assignment](#) to [this](#).
3. [Append](#) *node* to *nodesSet*.
4. Set [this](#)'s [manually assigned nodes](#) to *nodesSet*.
5. Run [assign slottables for a tree](#) for [this](#)'s [root](#).

4.12.5 The **canvas** element



[Element/canvas](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+



[HTMLCanvasElement](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Categories:

[Flow content](#).

[Phrasing content](#).

[Embedded content](#).

[Palpable content](#).

Contexts in which this element can be used:

Where [embedded content](#) is expected.

Content model:

[Transparent](#), but with no [interactive content](#) descendants except for [a](#) elements, [img](#)

elements with `usemap` attributes, `button` elements, `input` elements whose `type` attribute are in the `Checkbox` or `Radio Button` states, `input` elements that are `buttons`, and `select` elements with a `multiple` attribute or a `display size` greater than 1.

Tag omission in text/html:

Neither tag is omissible.

Content attributes:

Global attributes

`width` — Horizontal dimension

`height` — Vertical dimension

Accessibility considerations:

For authors.

For implementers.

DOM interface:

```
typedef (CanvasRenderingContext2D or ImageBitmapRenderingContext or WebGLRenderingContext) DOMInterface<HTMLCanvasElement>;
```

[Exposed=Window]
interface `HTMLCanvasElement` : `HTMLElement` {
 [HTMLConstructor] constructor();

 [CEReactions] attribute unsigned long `width`;
 [CEReactions] attribute unsigned long `height`;

 `RenderingContext?` `getContext(DOMString contextId, optional any options = {})`;

 USVString `toDataURL(optional DOMString type = "image/png", optional any options = {})`;
 undefined `toBlob(BlobCallback callback, optional DOMString type = "image/png")`;
 OffscreenCanvas `transferControlToOffscreen()`;
};

callback `BlobCallback` = undefined (`Blob?` blob);

The `canvas` element provides scripts with a resolution-dependent bitmap canvas, which can be used for rendering graphs, game graphics, art, or other visual images on the fly.

Authors should not use the `canvas` element in a document when a more suitable element is available. For example, it is inappropriate to use a `canvas` element to render a page heading: if the desired presentation of the heading is graphically intense, it should be marked up using appropriate elements (typically `h1`) and then styled using CSS and supporting technologies such as `shadow trees`.

When authors use the [canvas](#) element, they must also provide content that, when presented to the user, conveys essentially the same function or purpose as the [canvas](#)'s bitmap. This content may be placed as content of the [canvas](#) element. The contents of the [canvas](#) element, if any, are the element's [fallback content](#).

In interactive visual media, if [scripting is enabled](#) for the [canvas](#) element, and if support for [canvas](#) elements has been enabled, then the [canvas](#) element [represents embedded content](#) consisting of a dynamically created image, the element's bitmap.

In non-interactive, static, visual media, if the [canvas](#) element has been previously associated with a rendering context (e.g. if the page was viewed in an interactive visual medium and is now being printed, or if some script that ran during the page layout process painted on the element), then the [canvas](#) element [represents embedded content](#) with the element's current bitmap and size. Otherwise, the element represents its [fallback content](#) instead.

In non-visual media, and in visual media if [scripting is disabled](#) for the [canvas](#) element or if support for [canvas](#) elements has been disabled, the [canvas](#) element [represents its fallback content](#) instead.

When a [canvas](#) element [represents embedded content](#), the user can still focus descendants of the [canvas](#) element (in the [fallback content](#)). When an element is [focused](#), it is the target of keyboard interaction events (even though the element itself is not visible). This allows authors to make an interactive canvas keyboard-accessible: authors should have a one-to-one mapping of interactive regions to [focusable areas](#) in the [fallback content](#). (Focus has no effect on mouse interaction events.) [\[UIEVENTS\]](#)

An element whose nearest [canvas](#) element ancestor is [being rendered](#) and [represents embedded content](#) is an element that is *being used as relevant canvas fallback content*.

The [canvas](#) element has two attributes to control the size of the element's bitmap: [width](#) and [height](#). These attributes, when specified, must have values that are [valid non-negative integers](#). The [rules for parsing non-negative integers](#) must be used to *obtain their numeric values*. If an attribute is missing, or if parsing its value returns an error, then the default value must be used instead. The [width](#) attribute defaults to 300, and the [height](#) attribute defaults to 150.

When setting the value of the [width](#) or [height](#) attribute, if the [context mode](#) of the [canvas](#) element is set to [placeholder](#), the user agent must throw an ["InvalidStateError"](#) [DOMException](#) and leave the attribute's value unchanged.

The [intrinsic dimensions](#) of the [canvas](#) element when it [represents embedded content](#) are equal to the dimensions of the element's bitmap.

The user agent must use a square pixel density consisting of one pixel of image data per coordinate space unit for the bitmaps of a [canvas](#) and its rendering contexts.

A [canvas](#) element can be sized arbitrarily by a style sheet, its bitmap is then subject to the '[object-fit](#)' CSS property.

The bitmaps of [canvas](#) elements, the bitmaps of [ImageBitmap](#) objects, as well as some of the bitmaps of rendering contexts, such as those described in the sections on the [CanvasRenderingContext2D](#) and [ImageBitmapRenderingContext](#) objects below, have an *origin-clean* flag, which can be set to true or false. Initially, when the [canvas](#) element or [ImageBitmap](#) object is created, its bitmap's [origin-clean](#) flag must be set to true.

A [canvas](#) element can have a rendering context bound to it. Initially, it does not have a bound rendering context. To keep track of whether it has a rendering context or not, and what kind of rendering context it is, a [canvas](#) also has a *canvas context mode*, which is initially *none* but can be changed to either *placeholder*, *2d*, *bitmaprenderer*, *webgl*, *webgl2*, or *webgpu* by algorithms defined in this specification.

When its [canvas context mode](#) is *none*, a [canvas](#) element has no rendering context, and its bitmap must be [transparent black](#) with an [intrinsic width](#) equal to [the numeric value](#) of the element's [width](#) attribute and an [intrinsic height](#) equal to [the numeric value](#) of the element's [height](#) attribute, those values being interpreted in [CSS pixels](#), and being updated as the attributes are set, changed, or removed.

When its [canvas context mode](#) is *placeholder*, a [canvas](#) element has no rendering context. It serves as a placeholder for an [OffscreenCanvas](#) object, and the content of the [canvas](#) element is updated by calling the [commit\(\)](#) method of the [OffscreenCanvas](#) object's rendering context.

When a [canvas](#) element represents [embedded content](#), it provides a [paint source](#) whose width is the element's [intrinsic width](#), whose height is the element's [intrinsic height](#), and whose appearance is the element's bitmap.

Whenever the [width](#) and [height](#) content attributes are set, removed, changed, or redundantly set to the value they already have, then the user agent must perform the action from the row of the following table that corresponds to the [canvas](#) element's [context mode](#).

Context Mode	Action
2d	Follow the steps to set bitmap dimensions to the numeric values of the width and height content attributes.
webgl or webgl2	Follow the behavior defined in the WebGL specifications. [WEBGL]

<u>Context Mode</u>	Action
webgpu	Follow the behavior defined in <i>WebGPU</i> . [WEBGPU] If the context's bitmap mode is set to blank , run the steps to set an bitmaprenderer ImageBitmapRenderingContext 's output bitmap, passing the canvas element's rendering context.

[placeholder](#) Do nothing.

[none](#) Do nothing.

✓MDN

[HTMLCanvasElement/height](#)

Support in all current engines.

Firefox 1.5+ Safari 3+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

[HTMLCanvasElement/width](#)

Support in all current engines.

Firefox 1.5+ Safari 3+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

The *width* and *height* IDL attributes must [reflect](#) the respective content attributes of the same name, with the same defaults.

`context = canvas.getContext(contextId [, options])`

✓MDN

[HTMLCanvasElement/getContext](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns an object that exposes an API for drawing on the canvas. *contextId* specifies the desired API: "[2d](#)", "[bitmaprenderer](#)", "[webgl](#)", "[webgl2](#)", or "[webgpu](#)". *options* is handled by that API.

This specification defines the "[2d](#)" and "[bitmaprenderer](#)" contexts below. The WebGL specifications define the "[webgl](#)" and "[webgl2](#)" contexts. WebGPU defines the "[webgpu](#)" context. [\[WEBGL\]](#) [\[WEBGPU\]](#)

Returns null if *contextId* is not supported, or if the canvas has already been initialized with another context type (e.g., trying to get a "[2d](#)" context after getting a "[webgl](#)" context).

The `getContext(contextId, options)` method of the [canvas](#) element, when invoked, must run these steps:

1. If *options* is not an [object](#), then set *options* to null.
2. Set *options* to the result of [converting](#) *options* to a JavaScript value.
3. Run the steps in the cell of the following table whose column header matches this [canvas](#) element's [canvas context mode](#) and whose row header matches *contextId*:

	none	2d	bitmaprenderer	webgl or webgl2	
"2d"	Follow the 2D context creation algorithm defined in the section below, passing it this canvas element and <i>options</i> , to obtain a CanvasRenderingContext2D object; if this does not throw an exception, then set this canvas element's context mode to 2d , and return the CanvasRenderingContext2D object.	Return the same object as was returned the last time the method was invoked with this same first argument.	Return null.	Return null.	Return null.
"bitmaprenderer"	Follow the ImageBitmapRenderingContext	Return null.	Return the same object as null.	Return null.	Return null.

	<u>none</u>	2d	<u>bitmaprenderer</u>	<u>webgl</u> or <u>webgl2</u>
" <u>webgl</u> " or " <u>webgl2</u> ", if the user agent supports the WebGL feature in its current configuration	<p>creation algorithm defined in the section below, passing it this <u>canvas</u> element and <u>options</u>, to obtain an <u>ImageBitmapRenderingContext</u> object; then set this <u>canvas</u> element's <u>context mode</u> to <u>bitmaprenderer</u>, and return the <u>ImageBitmapRenderingContext</u> object.</p> <p>Follow the instructions given in the WebGL specifications' <i>Context Creation</i> sections to obtain a <u>WebGLRenderingContext</u>, <u>WebGL2RenderingContext</u>, or null; if the returned value is null, then return null; otherwise, set this <u>canvas</u> element's <u>context mode</u> to <u>webgl</u> or <u>webgl2</u>, and return the <u>WebGLRenderingContext</u> or <u>WebGL2RenderingContext</u> object. [WEBGL]</p>	was returned the last time the method was invoked with this same first argument.	Return the same object as was returned the last time the method was invoked with this same first argument.	Return null.
" <u>webgpu</u> ", if the user agent supports the WebGPU feature in its current configuration	<p>Follow the instructions given in <i>WebGPU's Canvas Rendering</i> section to obtain a <u>GPUCanvasContext</u> or null; if the returned value is null, then return null; otherwise, set this <u>canvas</u> element's <u>context mode</u> to <u>webgpu</u> and return the <u>GPUCanvasContext</u> object. [WEBGPU]</p>	Return null.	Return null.	Return null.
An unsupported value*	Return null.	Return null.	Return null.	Return null.

* For example, the "webgl" or "webgl2" value in the case of a user agent having exhausted the graphics hardware's abilities and having no software fallback implementation.

url = canvas.toDataURL([type [, quality]])

✓MDN

[HTMLCanvasElement/toDataURL](#)

Support in all current engines.

Firefox 2+ Safari 4+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+

Returns a [data: URL](#) for the image in the canvas.

The first argument, if provided, controls the type of the image to be returned (e.g. PNG or JPEG). The default is "[image/png](#)"; that type is also used if the given type isn't supported. The second argument applies if the type is an image format that supports variable quality (such as "[image/jpeg](#)"), and is a number in the range 0.0 to 1.0 inclusive indicating the desired quality level for the resulting image.

When trying to use types other than "[image/png](#)", authors can check if the image was really returned in the requested format by checking to see if the returned string starts with one of the exact strings "`data:image/png,`" or "`data:image/png;`". If it does, the image is PNG, and thus the requested type was not supported. (The one exception to this is if the canvas has either no height or no width, in which case the result might simply be "`data:,.`".)

[canvas.toBlob\(callback \[, type \[, quality\] \] \)](#)

✓MDN

[HTMLCanvasElement/toBlob](#)

Support in all current engines.

Firefox 18+ Safari 11+ Chrome 50+

Opera 37+ Edge 79+

Edge (Legacy) No Internet Explorer 10+

Firefox Android 18+ Safari iOS 11+ Chrome Android 50+ WebView Android 50+ Samsung Internet 5.0+ Opera Android 37+

Creates a [Blob](#) object representing a file containing the image in the canvas, and invokes a callback with a handle to that object.

The second argument, if provided, controls the type of the image to be returned (e.g. PNG or JPEG). The default is "[image/png](#)"; that type is also used if the given type isn't supported. The third argument applies if the type is an image format that supports

variable quality (such as "[image/jpeg](#)"), and is a number in the range 0.0 to 1.0 inclusive indicating the desired quality level for the resulting image.

`canvas.transferControlToOffscreen()`

MDN

[HTMLCanvasElement/transferControlToOffscreen](#)

Firefox 44+ Safari No Chrome 69+

Opera 56+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 44+ Safari iOS No Chrome Android 69+ WebView Android No Samsung Internet 10.0+ Opera Android 48+

Returns a newly created [OffscreenCanvas](#) object that uses the [canvas](#) element as a placeholder. Once the [canvas](#) element has become a placeholder for an [OffscreenCanvas](#) object, its intrinsic size can no longer be changed, and it cannot have a rendering context. The content of the placeholder canvas is updated by calling the [commit\(\)](#) method of the [OffscreenCanvas](#) object's rendering context.

The `toDataURL(type, quality)` method, when invoked, must run these steps:

1. If this [canvas](#) element's bitmap's [origin-clean](#) flag is set to false, then throw a "[SecurityError](#)" [DOMException](#).
2. If this [canvas](#) element's bitmap has no pixels (i.e. either its horizontal dimension or its vertical dimension is zero) then return the string "`data: ,`". (This is the shortest [data: URL](#); it represents the empty string in a [text/plain](#) resource.)
3. Let `file` be [a serialization of this canvas element's bitmap as a file](#), passing `type` and `quality` if given.
4. If `file` is null then return "`data: ,`".
5. Return a [data: URL](#) representing `file`. [\[RFC2397\]](#)

The `toBlob(callback, type, quality)` method, when invoked, must run these steps:

1. If this [canvas](#) element's bitmap's [origin-clean](#) flag is set to false, then throw a "[SecurityError](#)" [DOMException](#).
2. Let `result` be null.
3. If this [canvas](#) element's bitmap has pixels (i.e., neither its horizontal dimension nor its vertical dimension is zero), then set `result` to a copy of this [canvas](#) element's bitmap.

4. Run these steps [in parallel](#):

1. If *result* is non-null, then set *result* to [a serialization of *result* as a file](#) with *type* and *quality* if given.
2. [Queue an element task](#) on the *canvas blob serialization task source* given the [canvas](#) element to run these steps:
 1. If *result* is non-null, then set *result* to a new [Blob](#) object, created in the [relevant Realm](#) of this [canvas](#) element, representing *result*. [\[FILEAPI\]](#)
 2. [Invoke](#) *callback* with « *result* ».

The *transferControlToOffscreen()* method, when invoked, must run these steps:

1. If this [canvas](#) element's [context mode](#) is not set to [none](#), throw an ["InvalidStateError"](#) [DOMException](#).
2. Let *offscreenCanvas* be a new [OffscreenCanvas](#) object with its width and height equal to the values of the [width](#) and [height](#) content attributes of this [canvas](#) element.
3. Set the [placeholder canvas element](#) of *offscreenCanvas* to be a weak reference to this [canvas](#) element.
4. Set this [canvas](#) element's [context mode](#) to [placeholder](#).
5. Return *offscreenCanvas*.

4.12.5.1 The 2D rendering context

✓MDN

[CanvasRenderingContext2D](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

MDN

[CanvasImageSource](#)

CanvasGradient

Support in all current engines.

Firefox 3.6+ Safari 5.1+ Chrome 6+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+

CanvasPattern

Support in all current engines.

Firefox 3.6+ Safari 3.1+ Chrome 4+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+

TextMetrics

Support in all current engines.

Firefox 1.5+ Safari 4+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 31+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+

ImageData

Support in all current engines.

Firefox 14+ Safari 3.1+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 14+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+

```
typedef (HTMLImageElement or  
        SVGImageElement) HTMLOrSVGImageElement;
```

```
typedef (HTMLOrSVGImageElement or  
        HTMLVideoElement or  
        HTMLCanvasElement or
```

```
ImageBitmap or
OffscreenCanvas or
VideoFrame) CanvasImageSource;
```

```
enum PredefinedColorSpace { "srgb", "display-p3" };
```

```
enum CanvasFillRule { "nonzero", "evenodd" };
```

```
dictionary CanvasRenderingContext2DSettings {
    boolean alpha = true;
    boolean desynchronized = false;
    PredefinedColorSpace colorSpace = "srgb";
    boolean willReadFrequently = false;
};
```

```
enum ImageSmoothingQuality { "low", "medium", "high" };
```

```
[Exposed=Window]
interface CanvasRenderingContext2D {
    // back-reference to the canvas
    readonly attribute HTMLCanvasElement canvas;
```

```
    CanvasRenderingContext2DSettings getContextAttributes();
};
```

```
CanvasRenderingContext2D includes CanvasState;
CanvasRenderingContext2D includes CanvasTransform;
CanvasRenderingContext2D includes CanvasCompositing;
CanvasRenderingContext2D includes CanvasImageSmoothing;
CanvasRenderingContext2D includes CanvasFillStrokeStyles;
CanvasRenderingContext2D includes CanvasShadowStyles;
CanvasRenderingContext2D includes CanvasFilters;
CanvasRenderingContext2D includes CanvasRect;
CanvasRenderingContext2D includes CanvasDrawPath;
CanvasRenderingContext2D includes CanvasUserInterface;
CanvasRenderingContext2D includes CanvasText;
CanvasRenderingContext2D includes CanvasDrawImage;
CanvasRenderingContext2D includes CanvasImageData;
CanvasRenderingContext2D includes CanvasPathDrawingStyles;
CanvasRenderingContext2D includes CanvasTextDrawingStyles;
CanvasRenderingContext2D includes CanvasPath;
```

```
interface mixin CanvasState {
    // state
    undefined save(); // push state on state stack
    undefined restore(); // pop state stack and restore state
    undefined reset(); // reset the rendering context to its default state
    boolean isContextLost(); // return whether context is lost
```

```
};

interface mixin CanvasTransform {
    // transformations (default transform is the identity matrix)
    undefined scale(unrestricted double x, unrestricted double y);
    undefined rotate(unrestricted double angle);
    undefined translate(unrestricted double x, unrestricted double y);
    undefined transform(unrestricted double a, unrestricted double b, unrestricted double c, unrestricted double d, unrestricted double e, unrestricted double f);
    [NewObject] DOMMatrix getTransform();
    undefined setTransform(unrestricted double a, unrestricted double b, unrestricted double c, unrestricted double d);
    undefined setTransform(optional DOMMatrix2DInit transform = {});
    undefined resetTransform();
};

interface mixin CanvasCompositing {
    // compositing
    attribute unrestricted double globalAlpha; // (default 1.0)
    attribute DOMString globalCompositeOperation; // (default source-over)
};

interface mixin CanvasImageSmoothing {
    // image smoothing
    attribute boolean imageSmoothingEnabled; // (default true)
    attribute ImageSmoothingQuality imageSmoothingQuality; // (default low)
};

interface mixin CanvasFillStrokeStyles {
    // colors and styles (see also the CanvasPathDrawingStyles and CanvasTextDrawingStyles)
    attribute (DOMString or CanvasGradient or CanvasPattern) strokeStyle; // (default black)
    attribute (DOMString or CanvasGradient or CanvasPattern) fillStyle; // (default transparent)
    CanvasGradient createLinearGradient(double x0, double y0, double x1, double y1);
    CanvasGradient createRadialGradient(double x0, double y0, double r0, double x1, double y1);
    CanvasGradient createConicGradient(double startAngle, double x, double y);
    CanvasPattern? createPattern(CanvasImageSource image, [LegacyNullToEmptyString]);
};

interface mixin CanvasShadowStyles {
    // shadows
    attribute unrestricted double shadowOffsetX; // (default 0)
    attribute unrestricted double shadowOffsetY; // (default 0)
    attribute unrestricted double shadowBlur; // (default 0)
    attribute DOMString shadowColor; // (default transparent black)
};
```

```
interface mixin CanvasFilters {
  // filters
  attribute DOMString filter; // (default "none")
};

interface mixin CanvasRect {
  // rects
  undefined clearRect(unrestricted double x, unrestricted double y, unrestricted double width, unrestricted double height);
  undefined fillRect(unrestricted double x, unrestricted double y, unrestricted double width, unrestricted double height);
  undefined strokeRect(unrestricted double x, unrestricted double y, unrestricted double width, unrestricted double height);
};

interface mixin CanvasDrawPath {
  // path API (see also CanvasPath)
  undefined beginPath();
  undefined fill(optional CanvasFillRule fillRule = "nonzero");
  undefined fill(Path2D path, optional CanvasFillRule fillRule = "nonzero");
  undefined stroke();
  undefined stroke(Path2D path);
  undefined clip(optional CanvasFillRule fillRule = "nonzero");
  undefined clip(Path2D path, optional CanvasFillRule fillRule = "nonzero");
  boolean isPointInPath(unrestricted double x, unrestricted double y, optional CanvasPath path);
  boolean isPointInPath(Path2D path, unrestricted double x, unrestricted double y);
  boolean isPointInStroke(unrestricted double x, unrestricted double y);
  boolean isPointInStroke(Path2D path, unrestricted double x, unrestricted double y);
};

interface mixin CanvasUserInterface {
  undefined drawFocusIfNeeded(Element element);
  undefined drawFocusIfNeeded(Path2D path, Element element);
  undefined scrollPathIntoView();
  undefined scrollPathIntoView(Path2D path);
};

interface mixin CanvasText {
  // text (see also the CanvasPathDrawingStyles and CanvasTextDrawingStyles interfaces)
  undefined fillText(DOMString text, unrestricted double x, unrestricted double y);
  undefined strokeText(DOMString text, unrestricted double x, unrestricted double y);
  TextMetrics measureText(DOMString text);
};

interface mixin CanvasDrawImage {
  // drawing images
  undefined drawImage(CanvasImageSource image, unrestricted double dx, unrestricted double dy, unrestricted double width, unrestricted double height);
  undefined drawImage(CanvasImageSource image, unrestricted double dx, unrestricted double dy, unrestricted double sx, unrestricted double sy, unrestricted double width, unrestricted double height);
  undefined drawImage(CanvasImageSource image, unrestricted double sx, unrestricted double sy, unrestricted double dx, unrestricted double dy, unrestricted double width, unrestricted double height);
};
```

```

};

interface mixin CanvasImageData {
    // pixel manipulation
    ImageData createImageData([EnforceRange] long sw, [EnforceRange] long sh, op
    ImageData createImageData(ImageData imagedata);
    ImageData getImageData([EnforceRange] long sx, [EnforceRange] long sy, [EnforceRange] long
    undefined putImageData(ImageData imagedata, [EnforceRange] long dx, [EnforceRange] long dy, [EnforceRange] long
    undefined putImageData(ImageData imagedata, [EnforceRange] long dx, [EnforceRange] long dy, [EnforceRange] long
};

enum CanvasLineCap { "butt", "round", "square" };
enum CanvasLineJoin { "round", "bevel", "miter" };
enum CanvasTextAlign { "start", "end", "left", "right", "center" };
enum CanvasTextBaseline { "top", "hanging", "middle", "alphabetic", "ideographic" };
enum CanvasDirection { "ltr", "rtl", "inherit" };
enum CanvasFontKerning { "auto", "normal", "none" };
enum CanvasFontStretch { "ultra-condensed", "extra-condensed", "condensed", "normal" };
enum CanvasFontVariantCaps { "normal", "small-caps", "all-small-caps", "petite-caps" };
enum CanvasTextRendering { "auto", "optimizeSpeed", "optimizeLegibility", "geometricPrecision" };

interface mixin CanvasPathDrawingStyles {
    // line caps/joins
    attribute unrestricted double lineWidth; // (default 1)
    attribute CanvasLineCap lineCap; // (default "butt")
    attribute CanvasLineJoin lineJoin; // (default "miter")
    attribute unrestricted double miterLimit; // (default 10)

    // dashed lines
    undefined setLineDash(sequence<unrestricted double> segments); // default empty sequence
    sequence<unrestricted double> getLineDash();
    attribute unrestricted double lineDashOffset;
};

interface mixin CanvasTextDrawingStyles {
    // text
    attribute DOMString font; // (default 10px sans-serif)
    attribute CanvasTextAlign textAlign; // (default: "start")
    attribute CanvasTextBaseline textBaseline; // (default: "alphabetic")
    attribute CanvasDirection direction; // (default: "inherit")
    attribute double letterSpacing; // (default: 0)
    attribute CanvasFontKerning fontKerning; // (default: "auto")
    attribute CanvasFontStretch fontStretch; // (default: "normal")
    attribute CanvasFontVariantCaps fontVariantCaps; // (default: "normal")
    attribute CanvasTextRendering textRendering; // (default: "auto")
    attribute double wordSpacing; // (default: 0)
};

```

```
interface mixin CanvasPath {
  // shared path API methods
  undefined closePath\(\);
  undefined moveTo\(unrestricted double x, unrestricted double y\);
  undefined lineTo\(unrestricted double x, unrestricted double y\);
  undefined quadraticCurveTo\(unrestricted double cpx, unrestricted double cpy\);
  undefined bezierCurveTo\(unrestricted double cplx, unrestricted double cply\);
  undefined arcTo\(unrestricted double x1, unrestricted double y1, unrestricted double x2, unrestricted double y2, unrestricted double radius, boolean anticlockwise\);
  undefined rect\(unrestricted double x, unrestricted double y, unrestricted double width, unrestricted double height\);
  undefined roundRect\(unrestricted double x, unrestricted double y, unrestricted double width, unrestricted double height, unrestricted double radius\);
  undefined arc\(unrestricted double x, unrestricted double y, unrestricted double radius, unrestricted double startAngle, unrestricted double endAngle, boolean anticlockwise\);
  undefined ellipse\(unrestricted double x, unrestricted double y, unrestricted double width, unrestricted double height, unrestricted double rx, unrestricted double ry, unrestricted double rotation, boolean anticlockwise\);
};

[Exposed=(Window,Worker)]
interface CanvasGradient {
  // opaque object
  undefined addColorStop\(double offset, DOMString color\);
};

[Exposed=(Window,Worker)]
interface CanvasPattern {
  // opaque object
  undefined setTransform\(optional DOMMatrix2DInit transform = {}\);
};

[Exposed=(Window,Worker)]
interface TextMetrics {
  // x-direction
  readonly attribute double width; // advance width
  readonly attribute double actualBoundingBoxLeft;
  readonly attribute double actualBoundingBoxRight;

  // y-direction
  readonly attribute double fontBoundingBoxAscent;
  readonly attribute double fontBoundingBoxDescent;
  readonly attribute double actualBoundingBoxAscent;
  readonly attribute double actualBoundingBoxDescent;
  readonly attribute double emHeightAscent;
  readonly attribute double emHeightDescent;
  readonly attribute double hangingBaseline;
  readonly attribute double alphabeticBaseline;
  readonly attribute double ideographicBaseline;
};

dictionary ImageDataSettings {
```

```

    PredefinedColorSpace colorSpace;
};

[Exposed=(Window,Worker),
Serializable]
interface ImageData {
    constructor(unsigned long sw, unsigned long sh, optional ImageDataSettings settings);
    constructor(Uint8ClampedArray data, unsigned long sw, optional unsigned long sh, optional ImageDataSettings settings);
    readonly attribute unsigned long width;
    readonly attribute unsigned long height;
    readonly attribute Uint8ClampedArray data;
    readonly attribute PredefinedColorSpace colorSpace;
};

[Exposed=(Window,Worker)]
interface Path2D {
    constructor(optional (Path2D or DOMString) path);

    undefined addPath(Path2D path, optional DOMMatrix2DInit transform = {});
};

Path2D includes CanvasPath;

```

To maintain compatibility with existing web content, user agents need to enumerate methods defined in [CanvasUserInterface](#) immediately after the [stroke\(\)](#) method on [CanvasRenderingContext2D](#) objects.

```
context = canvas.getContext('2d' [, { [ alpha: true ] [, desynchronized: false ] [, colorSpace: 'srgb'] [, willReadFrequently: false ]} ])

```

Returns a [CanvasRenderingContext2D](#) object that is permanently bound to a particular [canvas](#) element.

If the [alpha](#) member is false, then the context is forced to always be opaque.

If the [desynchronized](#) member is true, then the context might be [desynchronized](#).

The [colorSpace](#) member specifies the [color space](#) of the rendering context.

If the [willReadFrequently](#) member is true, then the context is marked for [readback optimization](#).

[context.canvas](#)

✓MDN

[CanvasRenderingContext2D\(canvas\)](#)

Support in all current engines.

Firefox 1.5+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns the [canvas](#) element.

`attributes = context.getContextAttributes()`

Returns an object whose:

- [alpha](#) member is true if the context has an alpha channel, or false if it was forced to be opaque.
- [desynchronized](#) member is true if the context can be [desynchronized](#).
- [colorSpace](#) member is a string indicating the context's [color space](#).
- [willReadFrequently](#) member is true if the context is marked for [readback optimization](#).

A [CanvasRenderingContext2D](#) object has an *output bitmap* that is initialized when the object is created.

The [output bitmap](#) has an [origin-clean](#) flag, which can be set to true or false. Initially, when one of these bitmaps is created, its [origin-clean](#) flag must be set to true.

The [CanvasRenderingContext2D](#) object also has an [alpha](#) boolean. When a [CanvasRenderingContext2D](#) object's [alpha](#) is false, then its alpha channel must be fixed to 1.0 (fully opaque) for all pixels, and attempts to change the alpha component of any pixel must be silently ignored.

Thus, the bitmap of such a context starts off as [opaque black](#) instead of [transparent black](#); [clearRect\(\)](#) always results in [opaque black](#) pixels, every fourth byte from [getImageData\(\)](#) is always 255, the [putImageData\(\)](#) method effectively ignores every fourth byte in its input, and so on. However, the alpha component of styles and images drawn onto the canvas are still honoured up to the point where they would impact the [output bitmap](#)'s alpha channel; for instance, drawing a 50% transparent white square on a freshly created [output bitmap](#) with its [alpha](#) set to false will result in a fully-opaque gray square.

The [CanvasRenderingContext2D](#) object also has a [desynchronized](#) boolean. When a [CanvasRenderingContext2D](#) object's [desynchronized](#) is true, then the user agent may optimize the rendering of the canvas to reduce the latency, as measured from input events to rasterization, by desynchronizing the canvas paint cycle from the event loop, bypassing the ordinary user agent rendering algorithm, or both. Insofar as this mode involves bypassing the usual paint mechanisms, rasterization, or both, it might introduce visible tearing artifacts.

The user agent usually renders on a buffer which is not being displayed, quickly swapping it and the one being scanned out for presentation; the former buffer is called back buffer and the latter *front buffer*. A popular technique for reducing latency is called front buffer rendering, also known as *single buffer* rendering, where rendering happens in parallel and racily with the scanning out process. This technique reduces the latency at the price of potentially introducing tearing artifacts and can be used to implement in total or part of the [desynchronized](#) boolean.

[\[MULTIPLEBUFFERING\]](#)

The [desynchronized](#) boolean can be useful when implementing certain kinds of applications, such as drawing applications, where the latency between input and rasterization is critical.

The [CanvasRenderingContext2D](#) object also has a *will read frequently* boolean. When a [CanvasRenderingContext2D](#) object's [will read frequently](#) is true, the user agent may optimize the canvas for readback operations.

On most devices the user agent needs to decide whether to store the canvas's [output bitmap](#) on the GPU (this is also called "hardware accelerated"), or on the CPU (also called "software"). Most rendering operations are more performant for accelerated canvases, with the major exception being readback with [getImageData\(\)](#), [toDataURL\(\)](#), or [toBlob\(\)](#).

[CanvasRenderingContext2D](#) objects with [will read frequently](#) equal to true tell the user agent that the webpage is likely to perform many readback operations and that it is advantageous to use a software canvas.

The [CanvasRenderingContext2D](#) object also has a *color space* setting of type [PredefinedColorSpace](#). The [CanvasRenderingContext2D](#) object's [color space](#) indicates the color space for the [output bitmap](#).

The [getContextAttributes\(\)](#) method steps are to return «[["alpha"](#) → [this's alpha](#), ["desynchronized"](#) → [this's desynchronized](#), ["colorSpace"](#) → [this's color space](#), ["willReadFrequently"](#) → [this's will read frequently](#)]».

The [CanvasRenderingContext2D](#) 2D rendering context represents a flat linear Cartesian surface whose origin (0,0) is at the top left corner, with the coordinate space having *x* values increasing when going right, and *y* values increasing when going down. The *x*-coordinate of the right-most edge is equal to the width of the rendering context's [output bitmap](#) in [CSS pixels](#); similarly, the *y*-coordinate of the bottom-most edge is equal to the height of the rendering context's [output bitmap](#) in [CSS pixels](#).

The size of the coordinate space does not necessarily represent the size of the actual bitmaps that the user agent will use internally or during rendering. On high-definition displays, for instance, the user agent may internally use bitmaps with four device pixels per unit in the coordinate space, so that the rendering remains at high quality throughout. Anti-aliasing can similarly be implemented using oversampling with bitmaps of a higher resolution than the final image on the display.

Using [CSS pixels](#) to describe the size of a rendering context's [output bitmap](#) does not mean that

when rendered the canvas will cover an equivalent area in [CSS pixels](#). [CSS pixels](#) are reused for ease of integration with CSS features, such as text layout.

In other words, the [canvas](#) element below's rendering context has a 200x200 [output bitmap](#) (which internally uses [CSS pixels](#) as a unit for ease of integration with CSS) and is rendered as 100x100 [CSS pixels](#):

```
<canvas width=200 height=200 style="width:100px; height:100px">
```

The *2D context creation algorithm*, which is passed a *target* (a [canvas](#) element) and *options*, consists of running these steps:

1. Let *settings* be the result of [converting options to the dictionary type \[CanvasRenderingContext2DSettings\]\(#\)](#). (This can throw an exception.).
 2. Let *context* be a new [CanvasRenderingContext2D](#) object.
 3. Initialize *context*'s [canvas](#) attribute to point to *target*.
 4. Set *context*'s [output bitmap](#) to the same bitmap as *target*'s bitmap (so that they are shared).
 5. Set [bitmap dimensions](#) to [the numeric values](#) of *target*'s [width](#) and [height](#) content attributes.
 6. Set *context*'s [alpha](#) to *settings*[["alpha"](#)].
 7. Set *context*'s [desynchronized](#) to *settings*[["desynchronized"](#)].
 8. Set *context*'s [color space](#) to *settings*[["colorSpace"](#)].
 9. Set *context*'s [will read frequently](#) to *settings*[["willReadFrequently"](#)].
 10. Return *context*.
-

When the user agent is to *set bitmap dimensions* to *width* and *height*, it must run these steps:

1. [Reset the rendering context to its default state](#).
2. Resize the [output bitmap](#) to the new *width* and *height*.
3. Let *canvas* be the [canvas](#) element to which the rendering context's [canvas](#) attribute was initialized.
4. If [the numeric value](#) of *canvas*'s [width](#) content attribute differs from *width*, then set

canvas's [width](#) content attribute to the shortest possible string representing *width* as a [valid non-negative integer](#).

5. If [the numeric value](#) of *canvas*'s [height](#) content attribute differs from *height*, then set *canvas*'s [height](#) content attribute to the shortest possible string representing *height* as a [valid non-negative integer](#).

Only one square appears to be drawn in the following example:

```
// canvas is a reference to a <canvas> element
var context = canvas.getContext('2d');
context.fillRect(0,0,50,50);
canvas.setAttribute('width', '300'); // clears the canvas
context.fillRect(0,100,50,50);
canvas.width = canvas.width; // clears the canvas
context.fillRect(100,0,50,50); // only this square remains
```

The *canvas* attribute must return the value it was initialized to when the object was created.

The [PredefinedColorSpace](#) enumeration is used to specify the [color space](#) of the canvas's backing store.

The "*srgb*" value indicates the ['srgb'](#) color space.

The "*display-p3*" value indicates the ['display-p3'](#) color space.

Algorithms for converting between color spaces are found in the [Predefined color spaces](#) section of *CSS Color*. [\[CSSCOLOR\]](#)

The [CanvasFillRule](#) enumeration is used to select the *fill rule* algorithm by which to determine if a point is inside or outside a path.

The value "*nonzero*" value indicates the nonzero winding rule, wherein a point is considered to be outside a shape if the number of times a half-infinite straight line drawn from that point crosses the shape's path going in one direction is equal to the number of times it crosses the path going in the other direction.

The "**evenodd**" value indicates the even-odd rule, wherein a point is considered to be outside a shape if the number of times a half-infinite straight line drawn from that point crosses the shape's path is even.

If a point is not outside a shape, it is inside the shape.

The [ImageSmoothingQuality](#) enumeration is used to express a preference for the interpolation quality to use when smoothing images.

The "*low*" value indicates a preference for a low level of image interpolation quality. Low-quality image interpolation may be more computationally efficient than higher settings.

The "*medium*" value indicates a preference for a medium level of image interpolation quality.

The "*high*" value indicates a preference for a high level of image interpolation quality. High-quality image interpolation may be more computationally expensive than lower settings.

Bilinear scaling is an example of a relatively fast, lower-quality image-smoothing algorithm. Bicubic or Lanczos scaling are examples of image-smoothing algorithms that produce higher-quality output. This specification does not mandate that specific interpolation algorithms be used.

4.12.5.1.1 Implementation notes

This section is non-normative.

The [output bitmap](#), when it is not directly displayed by the user agent, implementations can, instead of updating this bitmap, merely remember the sequence of drawing operations that have been applied to it until such time as the bitmap's actual data is needed (for example because of a call to [drawImage\(\)](#), or the [createImageBitmap\(\)](#) factory method). In many cases, this will be more memory efficient.

The bitmap of a [canvas](#) element is the one bitmap that's pretty much always going to be needed in practice. The [output bitmap](#) of a rendering context, when it has one, is always just an alias to a [canvas](#) element's bitmap.

Additional bitmaps are sometimes needed, e.g. to enable fast drawing when the canvas is being painted at a different size than its [intrinsic size](#), or to enable double buffering so that graphics updates, like page scrolling for example, can be processed concurrently while canvas draw commands are being executed.

4.12.5.1.2 The canvas state

Objects that implement the [CanvasState](#) interface maintain a stack of drawing states. Drawing states consist of:

- The current [transformation matrix](#).
- The current [clipping region](#).
- The current values of the following attributes: [strokeStyle](#), [fillStyle](#), [globalAlpha](#), [lineWidth](#), [lineCap](#), [lineJoin](#), [miterLimit](#), [lineDashOffset](#), [shadowOffsetX](#), [shadowOffsetY](#), [shadowBlur](#), [shadowColor](#), [filter](#), [globalCompositeOperation](#), [font](#), [textAlign](#), [textBaseline](#), [direction](#),

[letterSpacing](#), [fontKerning](#), [fontStretch](#), [fontVariantCaps](#),
[textRendering](#), [wordSpacing](#), [imageSmoothingEnabled](#),
[imageSmoothingQuality](#).

- The current [dash list](#).

The rendering context's bitmaps are not part of the drawing state, as they depend on whether and how the rendering context is bound to a [canvas](#) element.

Objects that implement the [CanvasState](#) mixin have a *context lost* boolean, that is initialized to false when the object is created. The [context lost](#) value is updated in the [context lost steps](#).

`context.save()`



[CanvasRenderingContext2D/save](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Pushes the current state onto the stack.

`context.restore()`



[CanvasRenderingContext2D/restore](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Pops the top state on the stack, restoring the context to that state.

`context.reset()`

Resets the rendering context, which includes the backing buffer, the drawing state stack, path, and styles.

`context.isContextLost()`

Returns true if the rendering context was lost. Context loss can occur due to driver crashes, running out of memory, etc. In these cases, the canvas loses its backing storage and takes steps to [reset the rendering context to its default state](#).

The `save()` method steps are to push a copy of the current drawing state onto the drawing state stack.

The `restore()` method steps are to pop the top entry in the drawing state stack, and reset the drawing state it describes. If there is no saved state, then the method must do nothing.

The `reset()` method steps are to [reset the rendering context to its default state](#).

To *reset the rendering context to its default state*:

1. Clear canvas's bitmap to [transparent black](#).
2. Empty the list of subpaths in context's [current default path](#).
3. Clear the context's drawing state stack.
4. Reset everything that [drawing state](#) consists of to their initial values.

The `isContextLost()` method steps are to return [this's context lost](#).

4.12.5.1.3 Line styles

`context.lineWidth [= value]`

✓MDN

[CanvasRenderingContext2D/lineWidth](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

`styles.lineWidth [= value]`

Returns the current line width.

Can be set, to change the line width. Values that are not finite values greater than zero are ignored.

context.lineCap [= value]

✓MDN

[CanvasRenderingContext2D/lineCap](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

styles.lineCap [= value]

Returns the current line cap style.

Can be set, to change the line cap style.

The possible line cap styles are "butt", "round", and "square". Other values are ignored.

context.lineJoin [= value]

✓MDN

[CanvasRenderingContext2D/lineJoin](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

styles.lineJoin [= value]

Returns the current line join style.

Can be set, to change the line join style.

The possible line join styles are "bevel", "round", and "miter". Other values are ignored.

context.miterLimit [= value]

✓MDN

[CanvasRenderingContext2D/miterLimit](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

styles.miterLimit [= value]

Returns the current miter limit ratio.

Can be set, to change the miter limit ratio. Values that are not finite values greater than zero are ignored.

context.setLineDash(segments)

✓MDN

[CanvasRenderingContext2D/setLineDash](#)

Support in all current engines.

Firefox 27+ Safari 7+ Chrome 23+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 27+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 14+

styles.setLineDash(segments)

Sets the current line dash pattern (as used when stroking). The argument is a list of distances for which to alternately have the line on and the line off.

segments = context.getLineDash()

✓MDN

[CanvasRenderingContext2D/getLineDash](#)

Support in all current engines.

Firefox 27+ Safari 7+ Chrome 23+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 27+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 14+

segments = styles.getLineDash()

Returns a copy of the current line dash pattern. The array returned will always have an even number of entries (i.e. the pattern is normalized).

`context.lineDashOffset`

✓MDN

[CanvasRenderingContext2D/lineDashOffset](#)

Support in all current engines.

Firefox 27+ Safari 7+ Chrome 23+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 27+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 14+

`styles.lineDashOffset`

Returns the phase offset (in the same units as the line dash pattern).

Can be set, to change the phase offset. Values that are not finite values are ignored.

Objects that implement the [CanvasPathDrawingStyles](#) interface have attributes and methods (defined in this section) that control how lines are treated by the object.

The `lineWidth` attribute gives the width of lines, in coordinate space units. On getting, it must return the current value. On setting, zero, negative, infinite, and NaN values must be ignored, leaving the value unchanged; other values must change the current value to the new value.

When the object implementing the [CanvasPathDrawingStyles](#) interface is created, the `lineWidth` attribute must initially have the value 1.0.

The `lineCap` attribute defines the type of endings that UAs will place on the end of lines. The three valid values are "butt", "round", and "square".

On getting, it must return the current value. On setting, the current value must be changed to the new value.

When the object implementing the [CanvasPathDrawingStyles](#) interface is created, the `lineCap` attribute must initially have the value "butt".

The `lineJoin` attribute defines the type of corners that UAs will place where two lines meet. The three valid values are "bevel", "round", and "miter".

On getting, it must return the current value. On setting, the current value must be changed to the new value.

When the object implementing the [CanvasPathDrawingStyles](#) interface is created, the [lineJoin](#) attribute must initially have the value "miter".

When the [lineJoin](#) attribute has the value "miter", strokes use the miter limit ratio to decide how to render joins. The miter limit ratio can be explicitly set using the [miterLimit](#) attribute. On getting, it must return the current value. On setting, zero, negative, infinite, and NaN values must be ignored, leaving the value unchanged; other values must change the current value to the new value.

When the object implementing the [CanvasPathDrawingStyles](#) interface is created, the [miterLimit](#) attribute must initially have the value 10.0.

Each [CanvasPathDrawingStyles](#) object has a *dash list*, which is either empty or consists of an even number of non-negative numbers. Initially, the [dash list](#) must be empty.

The [setLineDash\(segments\)](#) method, when invoked, must run these steps:

1. If any value in *segments* is not finite (e.g. an Infinity or a NaN value), or if any value is negative (less than zero), then return (without throwing an exception; user agents could show a message on a developer console, though, as that would be helpful for debugging).
2. If the number of elements in *segments* is odd, then let *segments* be the concatenation of two copies of *segments*.
3. Let the object's [dash list](#) be *segments*.

When the [getLineDash\(\)](#) method is invoked, it must return a sequence whose values are the values of the object's [dash list](#), in the same order.

It is sometimes useful to change the "phase" of the dash pattern, e.g. to achieve a "marching ants" effect. The phase can be set using the [lineDashOffset](#) attribute. On getting, it must return the current value. On setting, infinite and NaN values must be ignored, leaving the value unchanged; other values must change the current value to the new value.

When the object implementing the [CanvasPathDrawingStyles](#) interface is created, the [lineDashOffset](#) attribute must initially have the value 0.0.

When a user agent is to *trace a path*, given an object *style* that implements the [CanvasPathDrawingStyles](#) interface, it must run the following algorithm. This algorithm returns a new [path](#).

1. Let *path* be a copy of the path being traced.

2. Prune all zero-length [line segments](#) from *path*.
3. Remove from *path* any subpaths containing no lines (i.e. subpaths with just one point).
4. Replace each point in each subpath of *path* other than the first point and the last point of each subpath by a *join* that joins the line leading to that point to the line leading out of that point, such that the subpaths all consist of two points (a starting point with a line leading out of it, and an ending point with a line leading into it), one or more lines (connecting the points and the joins), and zero or more joins (each connecting one line to another), connected together such that each subpath is a series of one or more lines with a join between each one and a point on each end.
5. Add a straight closing line to each closed subpath in *path* connecting the last point and the first point of that subpath; change the last point to a join (from the previously last line to the newly added closing line), and change the first point to a join (from the newly added closing line to the first line).
6. If *style*'s [dash list](#) is empty, then jump to the step labeled *convert*.
7. Let *pattern width* be the concatenation of all the entries of *style*'s [dash list](#), in coordinate space units.
8. For each subpath *subpath* in *path*, run the following substeps. These substeps mutate the subpaths in *path* *in vivo*.
 1. Let *subpath width* be the length of all the lines of *subpath*, in coordinate space units.
 2. Let *offset* be the value of *style*'s [lineDashOffset](#), in coordinate space units.
 3. While *offset* is greater than *pattern width*, decrement it by *pattern width*.
While *offset* is less than zero, increment it by *pattern width*.
 4. Define *L* to be a linear coordinate line defined along all lines in *subpath*, such that the start of the first line in the subpath is defined as coordinate 0, and the end of the last line in the subpath is defined as coordinate *subpath width*.
 5. Let *position* be zero minus *offset*.
 6. Let *index* be 0.
 7. Let *current state* be *off* (the other states being *on* and *zero-on*).
 8. *Dash on:* Let *segment length* be the value of *style*'s [dash list](#)'s *indexth* entry.
 9. Increment *position* by *segment length*.

10. If *position* is greater than *subpath width*, then end these substeps for this subpath and start them again for the next subpath; if there are no more subpaths, then jump to the step labeled *convert* instead.
11. If *segment length* is nonzero, then let *current state* be *on*.
12. Increment *index* by one.
13. *Dash off*: Let *segment length* be the value of *style*'s [dash list](#)'s *indexth* entry.
14. Let *start* be the offset *position* on *L*.
15. Increment *position* by *segment length*.
16. If *position* is less than zero, then jump to the step labeled *post-cut*.
17. If *start* is less than zero, then let *start* be zero.
18. If *position* is greater than *subpath width*, then let *end* be the offset *subpath width* on *L*. Otherwise, let *end* be the offset *position* on *L*.
19. Jump to the first appropriate step:

If *segment length* is zero and *current state* is *off*

Do nothing, just continue to the next step.

If *current state* is *off*

Cut the line on which *end* finds itself short at *end* and place a point there, cutting in two the subpath that it was in; remove all line segments, joins, points, and subpaths that are between *start* and *end*; and finally place a single point at *start* with no lines connecting to it.

The point has a *directionality* for the purposes of drawing line caps (see below). The directionality is the direction that the original line had at that point (i.e. when *L* was defined above).

Otherwise

Cut the line on which *start* finds itself into two at *start* and place a point there, cutting in two the subpath that it was in, and similarly cut the line on which *end* finds itself short at *end* and place a point there, cutting in two the subpath that it was in, and then remove all line segments, joins, points, and subpaths that are between *start* and *end*.

If *start* and *end* are the same point, then this results in just the line being cut in two and two points being inserted there, with nothing being removed,

unless a join also happens to be at that point, in which case the join must be removed.

20. *Post-cut*: If *position* is greater than *subpath width*, then jump to the step labeled *convert*.
 21. If *segment length* is greater than zero, then let *positioned-at-on-dash* be false.
 22. Increment *index* by one. If it is equal to the number of entries in *style*'s [dash list](#), then let *index* be 0.
 23. Return to the step labeled *dash on*.
9. *Convert*: This is the step that converts the path to a new path that represents its stroke.

Create a new [path](#) that describes the edge of the areas that would be covered if a straight line of length equal to *style*'s [lineWidth](#) was swept along each subpath in *path* while being kept at an angle such that the line is orthogonal to the path being swept, replacing each point with the end cap necessary to satisfy *style*'s [lineCap](#) attribute as described previously and elaborated below, and replacing each join with the join necessary to satisfy *style*'s [lineJoin](#) type, as defined below.

Caps: Each point has a flat edge perpendicular to the direction of the line coming out of it. This is then augmented according to the value of *style*'s [lineCap](#). The "**butt**" value means that no additional line cap is added. The "**round**" value means that a semi-circle with the diameter equal to *style*'s [lineWidth](#) width must additionally be placed on to the line coming out of each point. The "**square**" value means that a rectangle with the length of *style*'s [lineWidth](#) width and the width of half *style*'s [lineWidth](#) width, placed flat against the edge perpendicular to the direction of the line coming out of the point, must be added at each point.

Points with no lines coming out of them must have two caps placed back-to-back as if it was really two points connected to each other by an infinitesimally short straight line in the direction of the point's *directionality* (as defined above).

Joins: In addition to the point where a join occurs, two additional points are relevant to each join, one for each line: the two corners found half the line width away from the join point, one perpendicular to each line, each on the side furthest from the other line.

A triangle connecting these two opposite corners with a straight line, with the third point of the triangle being the join point, must be added at all joins. The [lineJoin](#) attribute controls whether anything else is rendered. The three aforementioned values have the following meanings:

The "**bevel**" value means that this is all that is rendered at joins.

The "**round**" value means that an arc connecting the two aforementioned corners of the

join, abutting (and not overlapping) the aforementioned triangle, with the diameter equal to the line width and the origin at the point of the join, must be added at joins.

The "miter" value means that a second triangle must (if it can given the miter length) be added at the join, with one line being the line between the two aforementioned corners, abutting the first triangle, and the other two being continuations of the outside edges of the two joining lines, as long as required to intersect without going over the miter length.

The miter length is the distance from the point where the join occurs to the intersection of the line edges on the outside of the join. The miter limit ratio is the maximum allowed ratio of the miter length to half the line width. If the miter length would cause the miter limit ratio (as set by *style*'s [miterLimit](#) attribute) to be exceeded, then this second triangle must not be added.

The subpaths in the newly created path must be oriented such that for any point, the number of times a half-infinite straight line drawn from that point crosses a subpath is even if and only if the number of times a half-infinite straight line drawn from that same point crosses a subpath going in one direction is equal to the number of times it crosses a subpath going in the other direction.

10. Return the newly created path.

4.12.5.1.4 Text styles

`context.font [= value]`

✓MDN

[CanvasRenderingContext2D/font](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

`styles.font [= value]`

Returns the current font settings.

Can be set, to change the font. The syntax is the same as for the CSS [font](#) property; values that cannot be parsed as CSS font values are ignored.

Relative keywords and lengths are computed relative to the font of the [canvas](#) element.

context.textAlign [= value]

✓MDN

[CanvasRenderingContext2D/textAlign](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

styles.textAlign [= value]

Returns the current text alignment settings.

Can be set, to change the alignment. The possible values are and their meanings are given below. Other values are ignored. The default is "start".

context.textBaseline [= value]

✓MDN

[CanvasRenderingContext2D/textBaseline](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

styles.textBaseline [= value]

Returns the current baseline alignment settings.

Can be set, to change the baseline alignment. The possible values and their meanings are given below. Other values are ignored. The default is "[alphabetic](#)".

context.direction [= value]

MDN

[CanvasRenderingContext2D/direction](#)

FirefoxNoSafari9+Chrome77+

Opera64+Edge79+

Edge (Legacy)NoInternetExplorerNo

Firefox Android No Safari iOS9+ Chrome Android77+ WebView Android77+ Samsung

Internet12.0+ Opera Android55+

`styles.direction [= value]`

Returns the current directionality.

Can be set, to change the directionality. The possible values and their meanings are given below. Other values are ignored. The default is "[inherit](#)".

`context.letterSpacing [= value]`

`styles.letterSpacing [= value]`

Returns the current spacing between characters in the text.

Can be set, to change spacing between characters. Positive values spreads characters further apart, while negative values brings them closer together. The default is 0.

`context.fontKerning [= value]`

`styles.fontKerning [= value]`

Returns the current font kerning settings.

Can be set, to change the font kerning. The possible values and their meanings are given below. Other values are ignored. The default is "[auto](#)".

`context.fontStretch [= value]`

`styles.fontStretch [= value]`

Returns the current font stretch settings.

Can be set, to change the font stretch. The possible values and their meanings are given below. Other values are ignored. The default is "[normal](#)".

`context.fontVariantCaps [= value]`

`styles.fontVariantCaps [= value]`

Returns the current font variant caps settings.

Can be set, to change the font variant caps. The possible values and their meanings are given below. Other values are ignored. The default is "[normal](#)".

`context.textRendering [= value]`

`styles.textRendering [= value]`

Returns the current text rendering settings.

Can be set, to change the text rendering. The possible values and their meanings are given below. Other values are ignored. The default is "[auto](#)".

`context.wordSpacing [= value]`
`styles.wordSpacing [= value]`

Returns the current spacing between words in the text.

Can be set, to change spacing between words. Positive values spreads words further apart, while negative values brings them closer together. The default is 0.

Objects that implement the [CanvasTextDrawingStyles](#) interface have attributes (defined in this section) that control how text is laid out (rasterized or outlined) by the object. Such objects can also have a *font style source object*. For [CanvasRenderingContext2D](#) objects, this is the [canvas](#) element given by the value of the context's [canvas](#) attribute. For [OffscreenCanvasRenderingContext2D](#) objects, this is the [associated OffscreenCanvas object](#).

Font resolution for the [font style source object](#) requires a [font source](#). This is determined for a given *object* implementing [CanvasTextDrawingStyles](#) by the following steps:

[\[CSSFONTLOAD\]](#)

1. If *object*'s [font style source object](#) is a [canvas](#) element, return the element's [node document](#).
2. Otherwise, *object*'s [font style source object](#) is an [OffscreenCanvas](#) object:
 1. Let *global* be *object*'s [relevant global object](#).
 2. If *global* is a [Window](#) object, then return *global*'s [associated Document](#).
 3. Assert: *global* implements [WorkerGlobalScope](#).
 4. Return *global*.

This is an example of font resolution with a regular [canvas](#) element with ID `c1`.

```
const font = new FontFace("MyCanvasFont", "url(mycanvasfont.ttf)");
documents.fonts.add(font);

const context = document.getElementById("c1").getContext("2d");
document.fonts.ready.then(function() {
  context.font = "64px MyCanvasFont";
  context.fillText("hello", 0, 0);
});
```

In this example, the canvas will display text using `mycanvasfont.ttf` as its font.

This is an example of how font resolution can happen using [OffscreenCanvas](#). Assuming a [canvas](#) element with ID `c2` which is transferred to a worker like so:

```
const offscreenCanvas = document.getElementById("c2").transferControlToOffscreen();
worker.postMessage(offscreenCanvas, [offscreenCanvas]);
```

Then, in the worker:

```
self.onmessage = function(ev) {
  const transferredCanvas = ev.data;
  const context = transferredCanvas.getContext("2d");
  const font = new FontFace("MyFont", "url(myfont.ttf)");
  self.fonts.add(font);
  self.fonts.ready.then(function() {
    context.font = "64px MyFont";
    context.fillText("hello", 0, 0);
  });
};
```

In this example, the canvas will display a text using `myfont.ttf`. Notice that the font is only loaded inside the worker, and not in the document context.

The `font` IDL attribute, on setting, must be [parsed as a CSS value](#) (but without supporting property-independent style sheet syntax like 'inherit'), and the resulting font must be assigned to the context, with the ['line-height'](#) component forced to 'normal', with the ['font-size'](#) component converted to [CSS pixels](#), and with system fonts being computed to explicit values. If the new value is syntactically incorrect (including using property-independent style sheet syntax like 'inherit' or 'initial'), then it must be ignored, without assigning a new font value. [\[CSS\]](#)

Font family names must be interpreted in the context of the [font style source object](#) when the font is to be used; any fonts embedded using `@font-face` or loaded using [FontFace](#) objects that are visible to the [font style source object](#) must therefore be available once they are loaded. (Each [font style source object](#) has a [font source](#), which determines what fonts are available.) If a font is used before it is fully loaded, or if the [font style source object](#) does not have that font in scope at the time the font is to be used, then it must be treated as if it was an unknown font, falling back to another as described by the relevant CSS specifications. [\[CSSFONTS\]](#)
[\[CSSFONTLOAD\]](#)

On getting, the `font` attribute must return the [serialized form](#) of the current font of the context (with no ['line-height'](#) component). [\[CSSOM\]](#)

For example, after the following statement:

```
context.font = 'italic 400 12px/2 Unknown Font, sans-serif';
```

...the expression `context.font` would evaluate to the string

`"italic 12px "Unknown Font", sans-serif".` The "400" font-weight doesn't appear because that is the default value. The line-height doesn't appear because it is forced to "normal", the default value.

When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the font of the context must be set to 10px sans-serif. When the '[font-size](#)' component is set to lengths using percentages, '[em](#)' or '[ex](#)' units, or the 'larger' or 'smaller' keywords, these must be interpreted relative to the [computed value](#) of the '[font-size](#)' property of the [font style source object](#) at the time that the attribute is set, if it is an element. When the '[font-weight](#)' component is set to the relative values 'bolder' and 'lighter', these must be interpreted relative to the [computed value](#) of the '[font-weight](#)' property of the [font style source object](#) at the time that the attribute is set, if it is an element. If the [computed values](#) are undefined for a particular case (e.g. because the [font style source object](#) is not an element or is not [being rendered](#)), then the relative keywords must be interpreted relative to the normal-weight 10px sans-serif default.

The [textAlign](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [textAlign](#) attribute must initially have the value [start](#).

The [textBaseline](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [textBaseline](#) attribute must initially have the value [alphabetic](#).

The [direction](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [direction](#) attribute must initially have the value "[inherit](#)".

The [letterSpacing](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value, where values may be positive or negative. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [letterSpacing](#) attribute must initially have the value 0.

The [fontKerning](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [fontKerning](#) attribute must initially have the value "[auto](#)".

The [fontStretch](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [fontStretch](#) attribute must initially have the value "[normal](#)".

The [fontVariantCaps](#) IDL attribute, on getting, must return the current value. On setting,

the current value must be changed to the new value. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [fontVariantCaps](#) attribute must initially have the value "[normal](#)".

The [textRendering](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [textRendering](#) attribute must initially have the value "[auto](#)".

The [wordSpacing](#) IDL attribute, on getting, must return the current value. On setting, the current value must be changed to the new value, where values may be positive or negative. When the object implementing the [CanvasTextDrawingStyles](#) interface is created, the [wordSpacing](#) attribute must initially have the value 0.

The [textAlign](#) attribute's allowed keywords are as follows:

start

Align to the start edge of the text (left side in left-to-right text, right side in right-to-left text).

end

Align to the end edge of the text (right side in left-to-right text, left side in right-to-left text).

left

Align to the left.

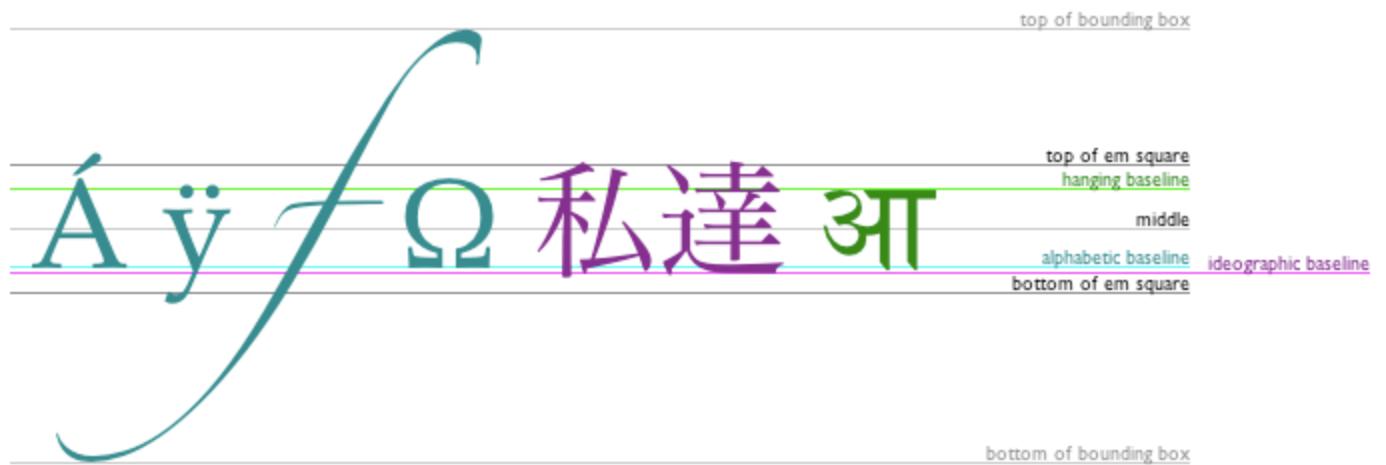
right

Align to the right.

center

Align to the center.

The [textBaseline](#) attribute's allowed keywords correspond to alignment points in the font:



The keywords map to these alignment points as follows:

top

The top of the em square

hanging

The [hanging baseline](#)

middle

The middle of the em square

alphabetic

The [alphabetic baseline](#)

ideographic

The [ideographic-under baseline](#)

bottom

The bottom of the em square

The [direction](#) attribute's allowed keywords are as follows:

ltr

Treat input to the [text preparation algorithm](#) as left-to-right text.

rtl

Treat input to the [text preparation algorithm](#) as right-to-left text.

inherit

Default to the directionality of the [canvas](#) element or [Document](#) as appropriate.

The [fontKerning](#) attribute's allowed keywords are as follows:

auto

Kerning is applied at the discretion of the user agent.

normal

Kerning is applied.

none

Kerning is not applied.

The [fontStretch](#) attribute's allowed keywords are as follows:

ultra-condensed

Same as CSS '[font-stretch](#)' '[ultra-condensed](#)' setting.

extra-condensed

Same as CSS '[font-stretch](#)' '[extra-condensed](#)' setting.

condensed

Same as CSS '[font-stretch](#)' '[condensed](#)' setting.

semi-condensed

Same as CSS '[font-stretch](#)' '[semi-condensed](#)' setting.

normal

The default setting, where width of the glyphs is at 100%.

semi-expanded

Same as CSS '[font-stretch](#)' '[semi-expanded](#)' setting.

expanded

Same as CSS '[font-stretch](#)' '[expanded](#)' setting.

extra-expanded

Same as CSS '[font-stretch](#)' '[extra-expanded](#)' setting.

ultra-expanded

Same as CSS '[font-stretch](#)' '[ultra-expanded](#)' setting.

The [fontVariantCaps](#) attribute's allowed keywords are as follows:

normal

None of the features listed below are enabled.

small-caps

Same as CSS '[font-variant-caps](#)' '[small-caps](#)' setting.

all-small-caps

Same as CSS '[font-variant-caps](#)' '[all-small-caps](#)' setting.

petite-caps

Same as CSS '[font-variant-caps](#)' '[petite-caps](#)' setting.

all-petite-caps

Same as CSS '[font-variant-caps](#)' '[all-petite-caps](#)' setting.

unicase

Same as CSS '[font-variant-caps](#)' '[unicase](#)' setting.

titling-caps

Same as CSS '[font-variant-caps](#)' '[titling-caps](#)' setting.

The [textRendering](#) attribute's allowed keywords are as follows:

auto

Same as 'auto' in [SVG text-rendering](#) property.

optimizeSpeed

Same as 'optimizeSpeed' in [SVG text-rendering](#) property.

optimizeLegibility

Same as 'optimizeLegibility' in [SVG text-rendering](#) property.

geometricPrecision

Same as 'geometricPrecision' in [SVG text-rendering](#) property.

The *text preparation algorithm* is as follows. It takes as input a string *text*, a [CanvasTextDrawingStyles](#) object *target*, and an optional length *maxWidth*. It returns an array of glyph shapes, each positioned on a common coordinate space, a *physical alignment* whose value is one of *left*, *right*, and *center*, and an [inline box](#). (Most callers of this algorithm ignore the *physical alignment* and the [inline box](#).)

1. If *maxWidth* was provided but is less than or equal to zero or equal to NaN, then return an empty array.
2. Replace all [ASCII whitespace](#) in *text* with U+0020 SPACE characters.
3. Let *font* be the current font of *target*, as given by that object's [font](#) attribute.
4. Apply the appropriate step from the following list to determine the value of *direction*:

If the *target* object's [direction](#) attribute has the value "[ltr](#)"

Let *direction* be '[ltr](#)'.

If the *target* object's [direction](#) attribute has the value "[rtl](#)"

Let *direction* be '[rtl](#)'.

If the *target* object's [font style source object](#) is an element

Let *direction* be [the directionality](#) of the *target* object's [font style source object](#).

If the *target* object's [font style source object](#) is a [Document](#) with a non-null [document element](#)

Let *direction* be [the directionality](#) of the *target* object's [font style source object](#)'s [document element](#).

Otherwise

Let *direction* be '[ltr](#)'.

5. Form a hypothetical infinitely-wide CSS [line box](#) containing a single [inline box](#) containing the text *text*, with its CSS properties set as follows:

Property	Source
'direction'	<i>direction</i>
'font'	<i>font</i>
'font-kerning'	<i>target</i> 's fontKerning

Property	Source
'font-stretch'	target's fontStretch
'font-variant-caps'	target's fontVariantCaps
'letter-spacing'	target's letterSpacing
SVG text-rendering	target's textRendering
'white-space'	'pre'
'word-spacing'	target's wordSpacing

and with all other properties set to their initial values.

6. If *maxWidth* was provided and the hypothetical width of the [inline box](#) in the hypothetical [line box](#) is greater than *maxWidth* [CSS pixels](#), then change *font* to have a more condensed font (if one is available or if a reasonably readable one can be synthesized by applying a horizontal scale factor to the font) or a smaller font, and return to the previous step.
7. The *anchor point* is a point on the [inline box](#), and the *physical alignment* is one of the values *left*, *right*, and *center*. These variables are determined by the [textAlign](#) and [textBaseline](#) values as follows:

Horizontal position:

If [textAlign](#) is **left**

If [textAlign](#) is **start** and *direction* is 'ltr'

If [textAlign](#) is **end** and *direction* is 'rtl'

Let the *anchor point*'s horizontal position be the left edge of the [inline box](#), and let *physical alignment* be *left*.

If [textAlign](#) is **right**

If [textAlign](#) is **end** and *direction* is 'ltr'

If [textAlign](#) is **start** and *direction* is 'rtl'

Let the *anchor point*'s horizontal position be the right edge of the [inline box](#), and let *physical alignment* be *right*.

If [textAlign](#) is **center**

Let the *anchor point*'s horizontal position be half way between the left and right edges of the [inline box](#), and let *physical alignment* be *center*.

Vertical position:

If [textBaseline](#) is **top**

Let the *anchor point*'s vertical position be the top of the em box of the [first available font](#) of the [inline box](#).

If [textBaseline](#) is **hanging**

Let the *anchor point*'s vertical position be the [hanging baseline](#) of the [first available](#)

font of the inline box.

If **textBaseline** is **middle**

Let the *anchor point*'s vertical position be half way between the bottom and the top of the em box of the first available font of the inline box.

If **textBaseline** is **alphabetic**

Let the *anchor point*'s vertical position be the alphabetic baseline of the first available font of the inline box.

If **textBaseline** is **ideographic**

Let the *anchor point*'s vertical position be the ideographic-under baseline of the first available font of the inline box.

If **textBaseline** is **bottom**

Let the *anchor point*'s vertical position be the bottom of the em box of the first available font of the inline box.

8. Let *result* be an array constructed by iterating over each glyph in the inline box from left to right (if any), adding to the array, for each glyph, the shape of the glyph as it is in the inline box, positioned on a coordinate space using CSS pixels with its origin is at the *anchor point*.
9. Return *result*, *physical alignment*, and the inline box.

4.12.5.1.5 Building paths

Objects that implement the **CanvasPath** interface have a path. A path has a list of zero or more subpaths. Each subpath consists of a list of one or more points, connected by straight or curved *line segments*, and a flag indicating whether the subpath is closed or not. A closed subpath is one where the last point of the subpath is connected to the first point of the subpath by a straight line. Subpaths with only one point are ignored when painting the path.

Paths have a *need new subpath* flag. When this flag is set, certain APIs create a new subpath rather than extending the previous one. When a path is created, its need new subpath flag must be set.

When an object implementing the **CanvasPath** interface is created, its path must be initialized to zero subpaths.

context.moveTo(x, y)

✓MDN

[CanvasRenderingContext2D/moveTo](#)

Support in all current engines.

Firefox1.5+Safari2+Chrome1+

Opera11.6+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12+

path.moveTo(x, y)

Creates a new subpath with the given point.

context.closePath()

✓MDN

[CanvasRenderingContext2D/closePath](#)

Support in all current engines.

Firefox1.5+Safari2+Chrome1+

Opera11.6+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12+

path.closePath()

Marks the current subpath as closed, and starts a new subpath with a point the same as the start and end of the newly closed subpath.

context.lineTo(x, y)

✓MDN

[CanvasRenderingContext2D/lineTo](#)

Support in all current engines.

Firefox1.5+Safari2+Chrome1+

Opera11.6+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12+

path.lineTo(x, y)

Adds the given point to the current subpath, connected to the previous one by a straight line.

context.quadraticCurveTo(cpx, cpy, x, y)

✓MDN

[CanvasRenderingContext2D/quadraticCurveTo](#)

Support in all current engines.

Firefox 1.5+ Safari 3+ Chrome 1+

Opera 11.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12+

path.quadraticCurveTo(cp_x, cp_y, x, y)

Adds the given point to the current subpath, connected to the previous one by a quadratic Bézier curve with the given control point.

context.bezierCurveTo(cp_{1x}, cp_{1y}, cp_{2x}, cp_{2y}, x, y)

✓MDN

[CanvasRenderingContext2D/bezierCurveTo](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 11.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12+

path.bezierCurveTo(cp_{1x}, cp_{1y}, cp_{2x}, cp_{2y}, x, y)

Adds the given point to the current subpath, connected to the previous one by a cubic Bézier curve with the given control points.

context.arcTo(x₁, y₁, x₂, y₂, radius)

✓MDN

[CanvasRenderingContext2D/arcTo](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 11.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

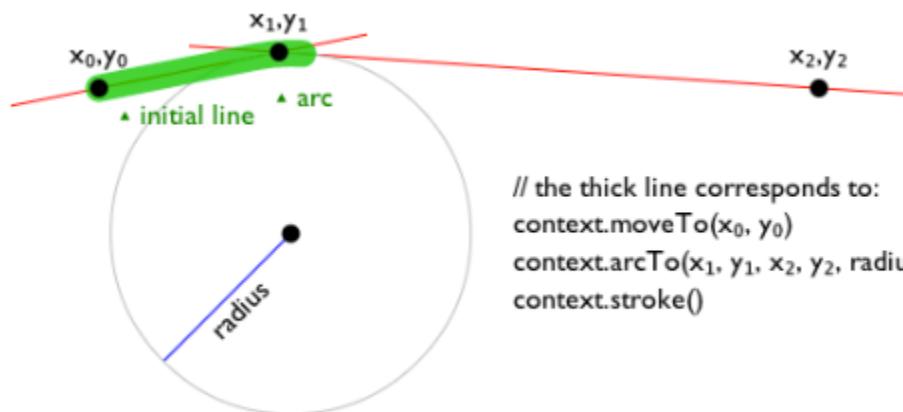
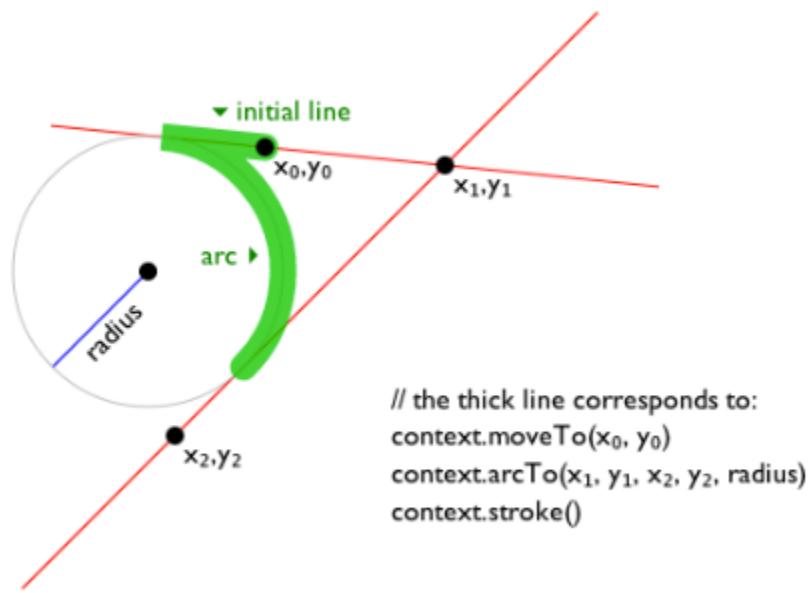
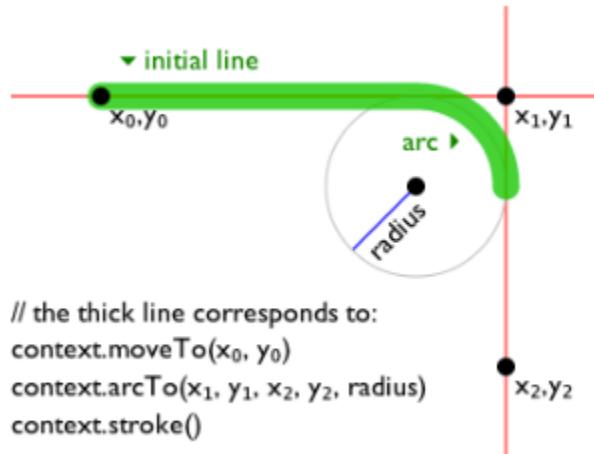
Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12+

path.arcTo(x₁, y₁, x₂, y₂, radius)

Adds an arc with the given control points and radius to the current subpath, connected to

the previous point by a straight line.

Throws an ["IndexSizeError" DOMException](#) if the given radius is negative.



`context.arc(x, y, radius, startAngle, endAngle [, counter-clockwise])`

✓MDN

[CanvasRenderingContext2D/arc](#)

Support in all current engines.

Firefox 1.5+ Safari 3+ Chrome 1+

Opera 11.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

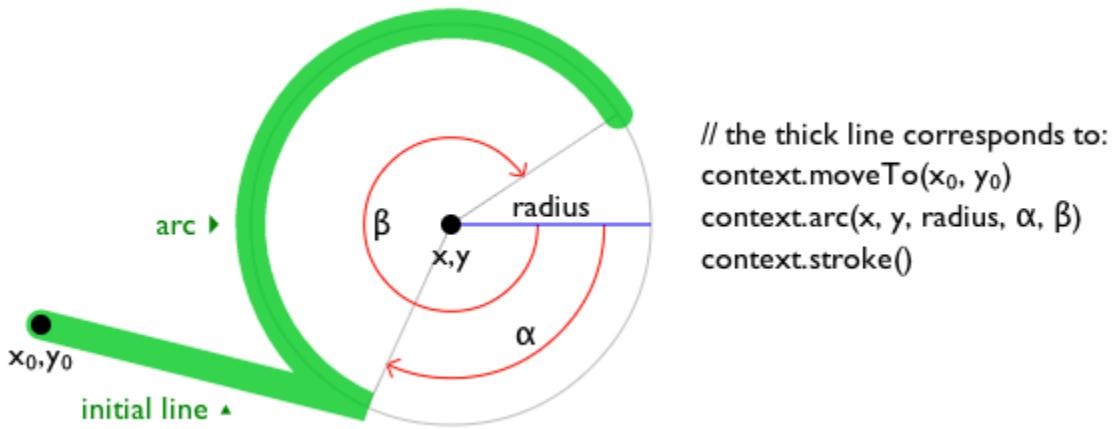
Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12+

`path.arc(x, y, radius, startAngle, endAngle [, counter-clockwise])`

Adds points to the subpath such that the arc described by the circumference of the circle described by the arguments, starting at the given start angle and ending at the given end angle, going in the given direction (defaulting to clockwise), is added to the path, connected to the previous point by a straight line.

Throws an ["IndexSizeError" DOMException](#) if the given radius is negative.



`context.ellipse(x, y, radiusX, radiusY, rotation, startAngle, endAngle [, counter-clockwise])`

✓MDN

[CanvasRenderingContext2D/ellipse](#)

Support in all current engines.

Firefox 48+ Safari 9+ Chrome 31+

Opera 18+ Edge 79+

Edge (Legacy) 13+
Internet Explorer No

Firefox 48+
Android 9+
Safari iOS 9+
Chrome Android 31+
WebView Android 4.4.3+
Samsung Internet 2.0+
Opera Android 18+

`path.ellipse(x, y, radiusX, radiusY, rotation, startAngle, endAngle [, counter-clockwise])`

Adds points to the subpath such that the arc described by the circumference of the ellipse described by the arguments, starting at the given start angle and ending at the given end angle, going in the given direction (defaulting to clockwise), is added to the path, connected to the previous point by a straight line.

Throws an ["IndexSizeError" DOMException](#) if the given radius is negative.

`context.rect(x, y, w, h)`

✓MDN

[CanvasRenderingContext2D/rect](#)

Support in all current engines.

Firefox 1.5+
Safari 2+
Chrome 1+

Opera 11.6+
Edge 79+

Edge (Legacy) 12+
Internet Explorer 9+

Firefox 4+
Android 4+
Safari iOS 1+
Chrome 18+
WebView Android 1+
Samsung Internet 1.0+
Opera Android 12+

`path.rect(x, y, w, h)`

Adds a new closed subpath to the path, representing the given rectangle.

`context.roundRect(x, y, w, h, radii)`

`path.roundRect(x, y, w, h, radii)`

Adds a new closed subpath to the path representing the given rounded rectangle. *radii* represents a list of radii for the corners of the rectangle, in pixels. The number and order of these radii function in the same way as the CSS ['border-radius'](#) property.

If *w* and *h* are both greater than or equal to 0, or if both are smaller than 0, then the path is drawn clockwise. Otherwise, it is drawn counterclockwise.

When *w* is negative, the rounded rectangle is flipped horizontally, which means that the radius values that normally apply to the left corners are used on the right and vice versa. Similarly, when *h* is negative, the rounded rect is flipped vertically.

When a value *r* in *radii* is a number, the corresponding corner(s) are drawn as circular arcs of radius *r*.

When a value *r* in *radii* is an object with { *x*, *y* } properties, the corresponding corner(s)

are drawn as elliptical arcs whose *x* and *y* radii are equal to *r.x* and *r.y*, respectively.

When the sum of the *radii* of two corners of the same edge is greater than the length of the edge, all the *radii* of the rounded rectangle are scaled by a factor of $\text{length} / (r1 + r2)$. If multiple edges have this property, the scale factor of the edge with the smallest scale factor is used. This is consistent with CSS behavior.

Throws a [RangeError](#) if *radii* not a list of size one, two, three, or four.

Throws a [RangeError](#) if a value in *radii* is a negative number, or is an { *x*, *y* } object whose *x* or *y* properties are negative numbers.

The following methods allow authors to manipulate the [paths](#) of objects implementing the [CanvasPath](#) interface.

For objects implementing the [CanvasDrawPath](#) and [CanvasTransform](#) interfaces, the points passed to the methods, and the resulting lines added to [current default path](#) by these methods, must be transformed according to the [current transformation matrix](#) before being added to the path.

The *moveTo(x, y)* method, when invoked, must run these steps:

1. If either of the arguments are infinite or NaN, then return.
2. Create a new subpath with the specified point as its first (and only) point.

When the user agent is to *ensure there is a subpath* for a coordinate (*x*, *y*) on a [path](#), the user agent must check to see if the [path](#) has its [need new subpath](#) flag set. If it does, then the user agent must create a new subpath with the point (*x*, *y*) as its first (and only) point, as if the [moveTo\(\)](#) method had been called, and must then unset the [path's need new subpath](#) flag.

The *closePath()* method, when invoked, must do nothing if the object's path has no subpaths. Otherwise, it must mark the last subpath as closed, create a new subpath whose first point is the same as the previous subpath's first point, and finally add this new subpath to the path.

If the last subpath had more than one point in its list of points, then this is equivalent to adding a straight line connecting the last point back to the first point of the last subpath, thus "closing" the subpath.

New points and the lines connecting them are added to subpaths using the methods described below. In all cases, the methods only modify the last subpath in the object's path.

The *lineTo(x, y)* method, when invoked, must run these steps:

1. If either of the arguments are infinite or NaN, then return.

2. If the object's path has no subpaths, then [ensure there is a subpath](#) for (x, y) .
3. Otherwise, connect the last point in the subpath to the given point (x, y) using a straight line, and then add the given point (x, y) to the subpath.

The `quadraticCurveTo(cpx, cpy, x, y)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. [Ensure there is a subpath](#) for (cpx, cpy)
3. Connect the last point in the subpath to the given point (x, y) using a quadratic Bézier curve with control point (cpx, cpy) . [\[BEZIER\]](#)
4. Add the given point (x, y) to the subpath.

The `bezierCurveTo(cp1x, cp1y, cp2x, cp2y, x, y)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
 2. [Ensure there is a subpath](#) for $(cp1x, cp1y)$.
 3. Connect the last point in the subpath to the given point (x, y) using a cubic Bézier curve with control points $(cp1x, cp1y)$ and $(cp2x, cp2y)$. [\[BEZIER\]](#)
 4. Add the point (x, y) to the subpath.
-

The `arcTo(x1, y1, x2, y2, radius)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. [Ensure there is a subpath](#) for $(x1, y1)$.
3. If `radius` is negative, then throw an ["IndexSizeError" DOMException](#).
4. Let the point $(x0, y0)$ be the last point in the subpath, transformed by the inverse of the [current transformation matrix](#) (so that it is in the same coordinate system as the points passed to the method).
5. If the point $(x0, y0)$ is equal to the point $(x1, y1)$, or if the point $(x1, y1)$ is equal to the point $(x2, y2)$, or if `radius` is zero, then add the point $(x1, y1)$ to the subpath, and connect that point to the previous point $(x0, y0)$ by a straight line.
6. Otherwise, if the points $(x0, y0)$, $(x1, y1)$, and $(x2, y2)$ all lie on a single straight line, then add the point $(x1, y1)$ to the subpath, and connect that point to the previous point $(x0, y0)$ by a straight line.

7. Otherwise, let *The Arc* be the shortest arc given by circumference of the circle that has radius *radius*, and that has one point tangent to the half-infinite line that crosses the point (x_0, y_0) and ends at the point (x_1, y_1) , and that has a different point tangent to the half-infinite line that ends at the point (x_1, y_1) and crosses the point (x_2, y_2) . The points at which this circle touches these two lines are called the start and end tangent points respectively. Connect the point (x_0, y_0) to the start tangent point by a straight line, adding the start tangent point to the subpath, and then connect the start tangent point to the end tangent point by *The Arc*, adding the end tangent point to the subpath.
-

The `arc(x, y, radius, startAngle, endAngle, counterclockwise)` method, when invoked, must run the [ellipse method steps](#) with this, *x*, *y*, *radius*, *radius*, 0, *startAngle*, *endAngle*, and *counterclockwise*.

This makes it equivalent to `ellipse()` except that both radii are equal and *rotation* is 0.

The `ellipse(x, y, radiusX, radiusY, rotation, startAngle, endAngle, counterclockwise)` method, when invoked, must run the [ellipse method steps](#) with this, *x*, *y*, *radiusX*, *radiusY*, *rotation*, *startAngle*, *endAngle*, and *counterclockwise*.

The *ellipse method steps*, given *canvasPath*, *x*, *y*, *radiusX*, *radiusY*, *rotation*, *startAngle*, *endAngle*, and *counterclockwise*, are:

1. If any of the arguments are infinite or NaN, then return.
2. If either *radiusX* or *radiusY* are negative, then throw an "[IndexSizeError](#)" [DOMException](#).
3. If *canvasPath*'s path has any subpaths, then add a straight line from the last point in the subpath to the start point of the arc.
4. Add the start and end points of the arc to the subpath, and connect them with an arc. The arc and its start and end points are defined as follows:

Consider an ellipse that has its origin at (x, y) , that has a major-axis radius *radiusX* and a minor-axis radius *radiusY*, and that is rotated about its origin such that its semi-major axis is inclined *rotation* radians clockwise from the x-axis.

If *counterclockwise* is false and *endAngle-startAngle* is equal to or greater than 2π , or, if *counterclockwise* is true and *startAngle-endAngle* is equal to or greater than 2π , then the arc is the whole circumference of this ellipse, and the point at *startAngle* along this circle's circumference, measured in radians clockwise from the ellipse's semi-major axis, acts as both the start point and the end point.

Otherwise, the points at *startAngle* and *endAngle* along this circle's circumference, measured in radians clockwise from the ellipse's semi-major axis, are the start and end points respectively, and the arc is the path along the circumference of this ellipse from

the start point to the end point, going counterclockwise if *counterclockwise* is true, and clockwise otherwise. Since the points are on the ellipse, as opposed to being simply angles from zero, the arc can never cover an angle greater than 2π radians.

Even if the arc covers the entire circumference of the ellipse and there are no other points in the subpath, the path is not closed unless the [closePath\(\)](#) method is appropriately invoked.

The *rect(x, y, w, h)* method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. Create a new subpath containing just the four points $(x, y), (x+w, y), (x+w, y+h), (x, y+h)$, in that order, with those four points connected by straight lines.
3. Mark the subpath as closed.
4. Create a new subpath with the point (x, y) as the only point in the subpath.

The *roundRect(x, y, w, h, radii)* method steps are:

1. If any of *x*, *y*, *w*, or *h* are infinite or NaN, then return.
2. If *radii* is not a list of size one, two, three, or four, then throw a [RangeError](#).
3. Let *normalizedRadii* be an empty list.
4. For each *radius* of *radii*:
 1. If *radius* is a [DOMPointInit](#):
 1. If *radius["x"]* or *radius["y"]* is infinite or NaN, then return.
 2. If *radius["x"]* or *radius["y"]* is negative, then throw a [RangeError](#).
 3. Otherwise, append *radius* to *normalizedRadii*.
 2. If *radius* is a [unrestricted_double](#):
 1. If *radius* is infinite or NaN, then return.
 2. If *radius* is negative, then throw a [RangeError](#).
 3. Otherwise append $\langle ["x" \rightarrow radius, "y" \rightarrow radius] \rangle$ to *normalizedRadii*.
5. Let *upperLeft*, *upperRight*, *lowerRight*, and *lowerLeft* be null.

6. If *normalizedRadii*'s size is 4, then set *upperLeft* to *normalizedRadii*[0], set *upperRight* to *normalizedRadii*[1], set *lowerRight* to *normalizedRadii*[2], and set *lowerLeft* to *normalizedRadii*[3].
7. If *normalizedRadii*'s size is 3, then set *upperLeft* to *normalizedRadii*[0], set *upperRight* and *lowerLeft* to *normalizedRadii*[1], and set *lowerRight* to *normalizedRadii*[2].
8. If *normalizedRadii*'s size is 2, then set *upperLeft* and *lowerRight* to *normalizedRadii*[0] and set *upperRight* and *lowerLeft* to *normalizedRadii*[1].
9. If *normalizedRadii*'s size is 1, then set *upperLeft*, *upperRight*, *lowerRight*, and *lowerLeft* to *normalizedRadii*[0].
10. Corner curves must not overlap. Scale all radii to prevent this:
 1. Let *top* be *upperLeft*[*X*] + *upperRight*[*X*].
 2. Let *right* be *upperRight*[*Y*] + *lowerRight*[*Y*].
 3. Let *bottom* be *lowerRight*[*X*] + *lowerLeft*[*X*].
 4. Let *left* be *upperLeft*[*Y*] + *lowerLeft*[*Y*].
 5. Let *scale* be the minimum value of the ratios w / top , $h / right$, $w / bottom$, $h / left$.
 6. If *scale* is less than 1, then set the *X* and *Y* members of *upperLeft*, *upperRight*, *lowerLeft*, and *lowerRight* to their current values multiplied by *scale*.
11. Create a new subpath:
 1. Move to the point $(x + upperLeft[X], y)$.
 2. Draw a straight line to the point $(x + w - upperRight[X], y)$.
 3. Draw an arc to the point $(x + w, y + upperRight[Y])$.
 4. Draw a straight line to the point $(x + w, y + h - lowerRight[Y])$.
 5. Draw an arc to the point $(x + w - lowerRight[X], y + h)$.
 6. Draw a straight line to the point $(x + lowerLeft[X], y + h)$.
 7. Draw an arc to the point $(x, y + h - lowerLeft[Y])$.
 8. Draw a straight line to the point $(x, y + upperLeft[Y])$.
 9. Draw an arc to the point $(x + upperLeft[X], y)$.

12. Mark the subpath as closed.
13. Create a new subpath with the point (x, y) as the only point in the subpath.

This is designed to behave similarly to the CSS '[border-radius](#)' property.

4.12.5.1.6 [Path2D](#) objects



[Path2D](#)

Support in all current engines.

Firefox 31+ Safari 8+ Chrome 36+

Opera 23+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 31+ Safari iOS 8+ Chrome Android 36+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

[Path2D](#) objects can be used to declare paths that are then later used on objects implementing the [CanvasDrawPath](#) interface. In addition to many of the APIs described in earlier sections, [Path2D](#) objects have methods to combine paths, and to add text to paths.

path = new Path2D()



[Path2D/Path2D](#)

Support in all current engines.

Firefox 31+ Safari 8+ Chrome 36+

Opera 23+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 31+ Safari iOS 8+ Chrome Android 36+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

Creates a new empty [Path2D](#) object.

path = new Path2D(path)

When *path* is a [Path2D](#) object, returns a copy.

When *path* is a string, creates the path described by the argument, interpreted as SVG path data. [\[SVG\]](#)

`path.addPath(path [, transform])`

✓MDN

[Path2D/addPath](#)

Support in all current engines.

Firefox 34+ Safari 9+ Chrome 68+

Opera 55+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 34+ Safari iOS 9+ Chrome Android 68+ WebView Android 68+ Samsung Internet 10.0+ Opera Android 48+

Adds to the path the path given by the argument.

The `Path2D(path)` constructor, when invoked, must run these steps:

1. Let `output` be a new [Path2D](#) object.
2. If `path` is not given, then return `output`.
3. If `path` is a [Path2D](#) object, then add all subpaths of `path` to `output` and return `output`.
(In other words, it returns a copy of the argument.)
4. Let `svgPath` be the result of parsing and interpreting `path` according to SVG 2's rules for path data. [\[SVG\]](#)

The resulting path could be empty. SVG defines error handling rules for parsing and applying path data.

5. Let (x, y) be the last point in `svgPath`.
6. Add all the subpaths, if any, from `svgPath` to `output`.
7. Create a new subpath in `output` with (x, y) as the only point in the subpath.
8. Return `output`.

The `addPath(path, transform)` method, when invoked on a [Path2D](#) object `a`, must run these steps:

1. If the [Path2D](#) object `path` has no subpaths, then return.
2. Let `matrix` be the result of [creating a DOMMatrix from the 2D dictionary](#) `transform`.
3. If one or more of `matrix`'s [m11 element](#), [m12 element](#), [m21 element](#), [m22 element](#), [m41](#)

[element](#), or [m42 element](#) are infinite or NaN, then return.

4. Create a copy of all the subpaths in *path*. Let this copy be known as *c*.
5. Transform all the coordinates and lines in *c* by the transform matrix *matrix*.
6. Let (x, y) be the last point in the last subpath of *c*.
7. Add all the subpaths in *c* to *a*.
8. Create a new subpath in *a* with (x, y) as the only point in the subpath.

4.12.5.1.7 Transformations

Objects that implement the [CanvasTransform](#) interface have a *current transformation matrix*, as well as methods (described in this section) to manipulate it. When an object implementing the [CanvasTransform](#) interface is created, its transformation matrix must be initialized to the identity matrix.

The [current transformation matrix](#) is applied to coordinates when creating the [current default path](#), and when painting text, shapes, and [Path2D](#) objects, on objects implementing the [CanvasTransform](#) interface.

The transformations must be performed in reverse order.

For instance, if a scale transformation that doubles the width is applied to the canvas, followed by a rotation transformation that rotates drawing operations by a quarter turn, and a rectangle twice as wide as it is tall is then drawn on the canvas, the actual result will be a square.

context.scale(x, y)

✓MDN

[CanvasRenderingContext2D/scale](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Changes the [current transformation matrix](#) to apply a scaling transformation with the given characteristics.

context.rotate(angle)

✓MDN

[CanvasRenderingContext2D/rotate](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Changes the [current transformation matrix](#) to apply a rotation transformation with the given characteristics. The angle is in radians.

context.translate(x, y)

✓MDN

[CanvasRenderingContext2D/translate](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Changes the [current transformation matrix](#) to apply a translation transformation with the given characteristics.

context.transform(a, b, c, d, e, f)

✓MDN

[CanvasRenderingContext2D/transform](#)

Support in all current engines.

Firefox 3+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Changes the [current transformation matrix](#) to apply the matrix given by the arguments as

described below.

`matrix = context.getTransform()`

✓MDN

[CanvasRenderingContext2D/getTransform](#)

Support in all current engines.

Firefox 70+ Safari 11+ Chrome 68+

Opera 55+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11+ Chrome Android 68+ WebView Android 68+ Samsung Internet 10.0+ Opera Android 48+

Returns a copy of the [current transformation matrix](#), as a newly created [DOMMatrix](#) object.

`context.setTransform(a, b, c, d, e, f)`

✓MDN

[CanvasRenderingContext2D/setTransform](#)

Support in all current engines.

Firefox 3+ Safari 4+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Changes the [current transformation matrix](#) to the matrix given by the arguments as described below.

`context.setTransform(transform)`

Changes the [current transformation matrix](#) to the matrix represented by the passed [DOMMatrix2DInit](#) dictionary.

`context.resetTransform()`

✓MDN

[CanvasRenderingContext2D/resetTransform](#)

Support in all current engines.

Firefox36+Safari10.1+Chrome31+

Opera18+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android36+Safari iOS10.3+Chrome Android31+WebView Android4.4+Samsung Internet2.0+Opera Android18+

Changes the [current transformation matrix](#) to the identity matrix.

The `scale(x, y)` method, when invoked, must run these steps:

1. If either of the arguments are infinite or NaN, then return.
2. Add the scaling transformation described by the arguments to the [current transformation matrix](#). The `x` argument represents the scale factor in the horizontal direction and the `y` argument represents the scale factor in the vertical direction. The factors are multiples.

The `rotate(angle)` method, when invoked, must run these steps:

1. If `angle` is infinite or NaN, then return.
2. Add the rotation transformation described by the argument to the [current transformation matrix](#). The `angle` argument represents a clockwise rotation angle expressed in radians.

The `translate(x, y)` method, when invoked, must run these steps:

1. If either of the arguments are infinite or NaN, then return.
2. Add the translation transformation described by the arguments to the [current transformation matrix](#). The `x` argument represents the translation distance in the horizontal direction and the `y` argument represents the translation distance in the vertical direction. The arguments are in coordinate space units.

The `transform(a, b, c, d, e, f)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. Replace the [current transformation matrix](#) with the result of multiplying the current transformation matrix with the matrix described by:

$$\begin{matrix} a & c & e \\ b & d & f \\ 0 & 0 & 1 \end{matrix}$$

The arguments `a`, `b`, `c`, `d`, `e`, and `f` are sometimes called `m11`, `m12`, `m21`, `m22`, `dx`, and `dy` or `m11`, `m21`, `m12`, `m22`, `dx`, and `dy`. Care ought to be taken in particular with the order of the second

and third arguments (b and c) as their order varies from API to API and APIs sometimes use the notation $m12/m21$ and sometimes $m21/m12$ for those positions.

The `getTransform()` method, when invoked, must return a newly created [DOMMatrix](#) representing a copy of the [current transformation matrix](#) matrix of the context.

This returned object is not live, so updating it will not affect the [current transformation matrix](#), and updating the [current transformation matrix](#) will not affect an already returned [DOMMatrix](#).

The `setTransform(a, b, c, d, e, f)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. Reset the [current transformation matrix](#) to the identity matrix.
3. Invoke the `transform(a, b, c, d, e, f)` method with the same arguments.

The `setTransform($transform$)` method, when invoked, must run these steps:

1. Let $matrix$ be the result of [creating a DOMMatrix from the 2D dictionary](#) $transform$.
2. If one or more of $matrix$'s [m11 element](#), [m12 element](#), [m21 element](#), [m22 element](#), [m41 element](#), or [m42 element](#) are infinite or NaN, then return.
3. Reset the [current transformation matrix](#) to $matrix$.

The `resetTransform()` method, when invoked, must reset the [current transformation matrix](#) to the identity matrix.

Given a matrix of the form created by the [transform\(\)](#) and [setTransform\(\)](#) methods, i.e.,

$\begin{matrix} a & c & e \\ b & d & f \\ 0 & 0 & 1 \end{matrix}$

the resulting transformed coordinates after transform matrix multiplication will be

$$\begin{aligned} x_{\text{new}} &= a x + c y + e \\ y_{\text{new}} &= b x + d y + f \end{aligned}$$

4.12.5.1.8 Image sources for 2D rendering contexts

Some methods on the [CanvasDrawImage](#) and [CanvasFillStrokeStyles](#) interfaces take the union type [CanvasImageSource](#) as an argument.

This union type allows objects implementing any of the following interfaces to be used as image sources:

- [HTMLOrSVGImageElement](#) ([img](#) or [SVG image](#) elements)
- [HTMLVideoElement](#) ([video](#) elements)
- [HTMLCanvasElement](#) ([canvas](#) elements)
- [ImageBitmap](#)
- [VideoFrame](#)

Although not formally specified as such, [SVG image](#) elements are expected to be implemented nearly identical to [img](#) elements. That is, [SVG image](#) elements share the fundamental concepts and features of [img](#) elements.

The [ImageBitmap](#) interface can be created from a number of other image-representing types, including [ImageData](#).

To check the usability of the *image* argument, where *image* is a [CanvasImageSource](#) object, run these steps:

1. Switch on *image*:

[HTMLOrSVGImageElement](#)

If *image*'s [current request's state](#) is [broken](#), then throw an "[InvalidStateError](#)" [DOMException](#).

If *image* is not [fully decodable](#), then return *bad*.

If *image* has an [intrinsic width](#) or [intrinsic height](#) (or both) equal to zero, then return *bad*.

[HTMLVideoElement](#)

If *image*'s [readyState](#) attribute is either [HAVE NOTHING](#) or [HAVE_METADATA](#), then return *bad*.

[HTMLCanvasElement](#)

[OffscreenCanvas](#)

If *image* has either a horizontal dimension or a vertical dimension equal to zero, then throw an "[InvalidStateError](#)" [DOMException](#).

[ImageBitmap](#)

[VideoFrame](#)

If *image*'s [\[\[Detached\]\]](#) internal slot value is set to true, then throw an "[InvalidStateError](#)" [DOMException](#).

2. Return *good*.

When a [CanvasImageSource](#) object represents an [HTMLOrSVGImageElement](#), the element's image must be used as the source image.

Specifically, when a [CanvasImageSource](#) object represents an animated image in an [HTMLOrSVGImageElement](#), the user agent must use the default image of the animation (the one that the format defines is to be used when animation is not supported or is disabled), or, if there is no such image, the first frame of the animation, when rendering the image for [CanvasRenderingContext2D](#) APIs.

When a [CanvasImageSource](#) object represents an [HTMLVideoElement](#), then the frame at the [current playback position](#) when the method with the argument is invoked must be used as the source image when rendering the image for [CanvasRenderingContext2D](#) APIs, and the source image's dimensions must be the [intrinsic width](#) and [intrinsic height](#) of the [media resource](#) (i.e., after any aspect-ratio correction has been applied).

When a [CanvasImageSource](#) object represents an [HTMLCanvasElement](#), the element's bitmap must be used as the source image.

When a [CanvasImageSource](#) object represents an element that is [being rendered](#) and that element has been resized, the original image data of the source image must be used, not the image as it is rendered (e.g. [width](#) and [height](#) attributes on the source element have no effect on how the object is interpreted when rendering the image for [CanvasRenderingContext2D](#) APIs).

When a [CanvasImageSource](#) object represents an [ImageBitmap](#), the object's bitmap image data must be used as the source image.

When a [CanvasImageSource](#) object represents a [VideoFrame](#), the object's pixel data must be used as the source image, and the source image's dimensions must be the object's [\[\[display width\]\]](#) and [\[\[display height\]\]](#).

An object *image* is not *origin-clean* if, switching on *image*'s type:

[HTMLOrSVGImageElement](#)

image's [current request](#)'s [image data](#) is [CORS-cross-origin](#).

[HTMLVideoElement](#)

image's [media data](#) is [CORS-cross-origin](#).

[HTMLCanvasElement](#)

[ImageBitmap](#)

image's bitmap's [origin-clean](#) flag is false.

`context.fillStyle [= value]`

✓MDN

[CanvasRenderingContext2D/fillStyle](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the current style used for filling shapes.

Can be set, to change the fill style.

The style can be either a string containing a CSS color, or a [CanvasGradient](#) or [CanvasPattern](#) object. Invalid values are ignored.

`context.strokeStyle [= value]`

✓MDN

[CanvasRenderingContext2D/strokeStyle](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the current style used for stroking shapes.

Can be set, to change the stroke style.

The style can be either a string containing a CSS color, or a [CanvasGradient](#) or [CanvasPattern](#) object. Invalid values are ignored.

Objects that implement the [CanvasFillStrokeStyles](#) interface have attributes and methods (defined in this section) that control how shapes are treated by the object.

Such objects have associated *fill style* and *stroke style* values, which are either CSS colors,

[CanvasPattern](#)s, or [CanvasGradient](#)s. Initially, both must be the result of [parsing](#) the string "#000000".

When the value is a CSS color, it must not be affected by the transformation matrix when used to draw on bitmaps.

When set to a [CanvasPattern](#) or [CanvasGradient](#) object, changes made to the object after the assignment do affect subsequent stroking or filling of shapes.

The `fillStyle` getter steps are:

1. If `this`'s [fill style](#) is a CSS color, then return the [serialization](#) of that color.
2. Return `this`'s [fill style](#).

The `fillStyle` setter steps are:

1. If the given value is a string, then:
 1. Let `parsedValue` be the result of [parsing](#) the given value with `this`'s [canvas](#) attribute's value.
 2. If `parsedValue` is failure, then return.
 3. Set `this`'s [fill style](#) to `parsedValue`.
 4. Return.
2. If the given value is a [CanvasPattern](#) object that is marked as [not origin-clean](#), then set `this`'s [origin-clean](#) flag to false.
3. Set `this`'s [fill style](#) to the given value.

The `strokeStyle` getter steps are:

1. If `this`'s [stroke style](#) is a CSS color, then return the [serialization](#) of that color.
2. Return `this`'s [stroke style](#).

The `strokeStyle` setter steps are:

1. If the given value is a string, then:
 1. Let `parsedValue` be the result of [parsing](#) the given value with `this`'s [canvas](#) attribute's value.
 2. If `parsedValue` is failure, then return.

3. Set `this`'s `stroke style` to `parsedValue`.
 4. Return.
2. If the given value is a `CanvasPattern` object that is marked as `not origin-clean`, then set `this`'s `origin-clean` flag to false.
 3. Set `this`'s `stroke style` to the given value.

The *serialization of a color* for a color value is a string, computed as follows: if it has alpha equal to 1.0, then the string is a lowercase six-digit hex value, prefixed with a "#" character (U+0023 NUMBER SIGN), with the first two digits representing the red component, the next two digits representing the green component, and the last two digits representing the blue component, the digits being [ASCII lower hex digits](#). Otherwise, the color value has alpha less than 1.0, and the string is the color value in the CSS `rgba()` functional-notation format: the literal string "`rgba`" (U+0072 U+0067 U+0062 U+0061) followed by a U+0028 LEFT PARENTHESIS, a base-ten integer in the range 0-255 representing the red component (using [ASCII digits](#) in the shortest form possible), a literal U+002C COMMA and U+0020 SPACE, an integer for the green component, a comma and a space, an integer for the blue component, another comma and space, a U+0030 DIGIT ZERO, if the alpha value is greater than zero then a U+002E FULL STOP (representing the decimal point), if the alpha value is greater than zero then one or more [ASCII digits](#) representing the fractional part of the alpha, and finally a U+0029 RIGHT PARENTHESIS. User agents must express the fractional part of the alpha value, if any, with the level of precision necessary for the alpha value, when reparsed, to be interpreted as the same alpha value.

There are three types of gradients, linear gradients, radial gradients, and conic gradients, represented by objects implementing the opaque `CanvasGradient` interface.

Once a gradient has been created (see below), stops are placed along it to define how the colors are distributed along the gradient. The color of the gradient at each stop is the color specified for that stop. Between each such stop, the colors and the alpha component must be linearly interpolated over the RGBA space without premultiplying the alpha value to find the color to use at that offset. Before the first stop, the color must be the color of the first stop. After the last stop, the color must be the color of the last stop. When there are no stops, the gradient is [transparent black](#).

`gradient.addColorStop(offset, color)`

✓MDN

[CanvasGradient/addColorStop](#)

Support in all current engines.

Firefox 3.6 + Safari 5.1 + Chrome 6 +

Opera 9 + Edge 79 +

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS6+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android10.1+

Adds a color stop with the given color to the gradient at the given offset. 0.0 is the offset at one end of the gradient, 1.0 is the offset at the other end.

Throws an "[IndexSizeError](#)" [DOMException](#) if the offset is out of range. Throws a "[SyntaxError](#)" [DOMException](#) if the color cannot be parsed.

`gradient = context.createLinearGradient(x0, y0, x1, y1)`

✓MDN

[CanvasRenderingContext2D/createLinearGradient](#)

Support in all current engines.

Firefox1.5+Safari2+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns a [CanvasGradient](#) object that represents a linear gradient that paints along the line given by the coordinates represented by the arguments.

`gradient = context.createRadialGradient(x0, y0, r0, x1, y1, r1)`

✓MDN

[CanvasRenderingContext2D/createRadialGradient](#)

Support in all current engines.

Firefox1.5+Safari2+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns a [CanvasGradient](#) object that represents a radial gradient that paints along the cone given by the circles represented by the arguments.

If either of the radii are negative, throws an "[IndexSizeError](#)" [DOMException](#) exception.

`gradient = context.createConicGradient(startAngle, x, y)`

[CanvasRenderingContext2D/createConicGradient](#)

Support in all current engines.

Firefox 90+ Safari 15+ Chrome 86+

Opera No Edge 86+

Edge (Legacy) No Internet Explorer No

Firefox Android 90+ Safari iOS 15+ Chrome Android 86+ WebView Android No Samsung Internet No Opera Android No

Returns a [CanvasGradient](#) object that represents a conic gradient that paints clockwise along the rotation around the center represented by the arguments.

The `addColorStop(offset, color)` method on the [CanvasGradient](#), when invoked, must run these steps:

1. If the `offset` is less than 0 or greater than 1, then throw an ["IndexSizeError" DOMException](#).
2. Let `parsed color` be the result of [parsing](#) `color`.

No element is passed to the parser because [CanvasGradient](#) objects are [canvas](#)-neutral — a [CanvasGradient](#) object created by one [canvas](#) can be used by another, and there is therefore no way to know which is the "element in question" at the time that the color is specified.

3. If `parsed color` is failure, throw a ["SyntaxError" DOMException](#).
4. Place a new stop on the gradient, at offset `offset` relative to the whole gradient, and with the color `parsed color`.

If multiple stops are added at the same offset on a gradient, then they must be placed in the order added, with the first one closest to the start of the gradient, and each subsequent one infinitesimally further along towards the end point (in effect causing all but the first and last stop added at each point to be ignored).

The `createLinearGradient(x0, y0, x1, y1)` method takes four arguments that represent the start point (x_0, y_0) and end point (x_1, y_1) of the gradient. The method, when invoked, must return a linear [CanvasGradient](#) initialized with the specified line.

Linear gradients must be rendered such that all points on a line perpendicular to the line that crosses the start and end points have the color at the point where those two lines cross (with the colors coming from the [interpolation and extrapolation](#) described above). The points in the linear gradient must be transformed as described by the [current transformation matrix](#) when rendering.

If $x_0 = x_1$ and $y_0 = y_1$, then the linear gradient must paint nothing.

The `createRadialGradient(x0, y0, r0, x1, y1, r1)` method takes six arguments, the first three representing the start circle with origin (x_0, y_0) and radius r_0 , and the last three representing the end circle with origin (x_1, y_1) and radius r_1 . The values are in coordinate space units. If either of r_0 or r_1 are negative, then an "[IndexSizeError DOMException](#)" must be thrown. Otherwise, the method, when invoked, must return a radial [CanvasGradient](#) initialized with the two specified circles.

Radial gradients must be rendered by following these steps:

1. If $x_0 = x_1$ and $y_0 = y_1$ and $r_0 = r_1$, then the radial gradient must paint nothing. Return.
2. Let $x(\omega) = (x_1 - x_0)\omega + x_0$

$$\text{Let } y(\omega) = (y_1 - y_0)\omega + y_0$$

$$\text{Let } r(\omega) = (r_1 - r_0)\omega + r_0$$

Let the color at ω be the color at that position on the gradient (with the colors coming from the [interpolation and extrapolation](#) described above).

3. For all values of ω where $r(\omega) > 0$, starting with the value of ω nearest to positive infinity and ending with the value of ω nearest to negative infinity, draw the circumference of the circle with radius $r(\omega)$ at position $(x(\omega), y(\omega))$, with the color at ω , but only painting on the parts of the bitmap that have not yet been painted on by earlier circles in this step for this rendering of the gradient.

This effectively creates a cone, touched by the two circles defined in the creation of the gradient, with the part of the cone before the start circle (0.0) using the color of the first offset, the part of the cone after the end circle (1.0) using the color of the last offset, and areas outside the cone untouched by the gradient ([transparent black](#)).

The resulting radial gradient must then be transformed as described by the [current transformation matrix](#) when rendering.

The `createConicGradient(startAngle, x, y)` method takes three arguments, the first argument, `startAngle`, represents the angle in radians at which the gradient begins, and the last two arguments, `(x, y)`, represent the center of the gradient in [CSS pixels](#). The method, when invoked, must return a conic [CanvasGradient](#) initialized with the specified center and angle.

It follows the same rendering rule as CSS '[conic-gradient](#)' and it is equivalent to CSS 'conic-gradient(from `adjustedStartAnglerad` at `xpx ypx`, `angularColorStopList`)'. Here:

- `adjustedStartAngle` is given by `startAngle + π/2`;
- `angularColorStopList` is given by the color stops that have been added to the

[CanvasGradient](#) using `addColorStop()`, with the color stop offsets interpreted as percentages.

Gradients must be painted only where the relevant stroking or filling effects requires that they be drawn.

Patterns are represented by objects implementing the opaque [CanvasPattern](#) interface.

`pattern = context.createPattern(image, repetition)`

✓MDN

[CanvasRenderingContext2D/createPattern](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns a [CanvasPattern](#) object that uses the given image and repeats in the direction(s) given by the *repetition* argument.

The allowed values for *repetition* are `repeat` (both directions), `repeat-x` (horizontal only), `repeat-y` (vertical only), and `no-repeat` (neither). If the *repetition* argument is empty, the value `repeat` is used.

If the image isn't yet fully decoded, then nothing is drawn. If the image is a canvas with no data, throws an "["InvalidStateError" DOMException](#)".

`pattern.setTransform(transform)`

✓MDN

[CanvasPattern/setTransform](#)

Support in all current engines.

Firefox 33+ Safari 11.1+ Chrome 68+

Opera 9+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 33+ Safari iOS 11.3+ Chrome Android 68+ WebView Android 68+ Samsung Internet 10.0+ Opera Android 10.1+

Sets the transformation matrix that will be used when rendering the pattern during a fill or

stroke painting operation.

The `createPattern(image, repetition)` method, when invoked, must run these steps:

1. Let *usability* be the result of [checking the usability of *image*](#).
2. If *usability* is *bad*, then return null.
3. Assert: *usability* is *good*.
4. If *repetition* is the empty string, then set it to "repeat".
5. If *repetition* is not [identical to one of "repeat", "repeat-x", "repeat-y", or "no-repeat"](#), then throw a ["SyntaxError" DOMException](#).
6. Let *pattern* be a new [CanvasPattern](#) object with the image *image* and the repetition behavior given by *repetition*.
7. If *image* [is not origin-clean](#), then mark *pattern* as *not origin-clean*.
8. Return *pattern*.

Modifying the *image* used when creating a [CanvasPattern](#) object after calling the [createPattern\(\)](#) method must not affect the pattern(s) rendered by the [CanvasPattern](#) object.

Patterns have a transformation matrix, which controls how the pattern is used when it is painted. Initially, a pattern's transformation matrix must be the identity matrix.

The `setTransform(transform)` method, when invoked, must run these steps:

1. Let *matrix* be the result of [creating a DOMMatrix from the 2D dictionary *transform*](#).
2. If one or more of *matrix*'s [m11 element](#), [m12 element](#), [m21 element](#), [m22 element](#), [m41 element](#), or [m42 element](#) are infinite or NaN, then return.
3. Reset the pattern's transformation matrix to *matrix*.

When a pattern is to be rendered within an area, the user agent must run the following steps to determine what is rendered:

1. Create an infinite [transparent black](#) bitmap.
2. Place a copy of the image on the bitmap, anchored such that its top left corner is at the origin of the coordinate space, with one coordinate space unit per [CSS pixel](#) of the image, then place repeated copies of this image horizontally to the left and right, if the repetition behavior is "repeat-x", or vertically up and down, if the repetition behavior is "repeat-y", or in all four directions all over the bitmap, if the repetition behavior is

"repeat".

If the original image data is a bitmap image, then the value painted at a point in the area of the repetitions is computed by filtering the original image data. When scaling up, if the [imageSmoothingEnabled](#) attribute is set to false, then the image must be rendered using nearest-neighbor interpolation. Otherwise, the user agent may use any filtering algorithm (for example bilinear interpolation or nearest-neighbor). User agents which support multiple filtering algorithms may use the value of the [imageSmoothingQuality](#) attribute to guide the choice of filtering algorithm. When such a filtering algorithm requires a pixel value from outside the original image data, it must instead use the value from wrapping the pixel's coordinates to the original image's dimensions. (That is, the filter uses 'repeat' behavior, regardless of the value of the pattern's repetition behavior.)

3. Transform the resulting bitmap according to the pattern's transformation matrix.
 4. Transform the resulting bitmap again, this time according to the [current transformation matrix](#).
 5. Replace any part of the image outside the area in which the pattern is to be rendered with [transparent black](#).
 6. The resulting bitmap is what is to be rendered, with the same origin and same scale.
-

If a radial gradient or repeated pattern is used when the transformation matrix is singular, then the resulting style must be [transparent black](#) (otherwise the gradient or pattern would be collapsed to a point or line, leaving the other pixels undefined). Linear gradients and solid colors always define all points even with singular transformation matrices.

4.12.5.1.10 Drawing rectangles to the bitmap

Objects that implement the [CanvasRect](#) interface provide the following methods for immediately drawing rectangles to the bitmap. The methods each take four arguments; the first two give the x and y coordinates of the top left of the rectangle, and the second two give the width w and height h of the rectangle, respectively.

The [current transformation matrix](#) must be applied to the following four coordinates, which form the path that must then be closed to get the specified rectangle: (x, y) , $(x+w, y)$, $(x+w, y+h)$, $(x, y+h)$.

Shapes are painted without affecting the [current default path](#), and are subject to the [clipping region](#), and, with the exception of [clearRect\(\)](#), also [shadow effects](#), [global alpha](#), and [global composition operators](#).

`context.clearRect(x, y, w, h)`

✓MDN

[CanvasRenderingContext2D/clearRect](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Clears all pixels on the bitmap in the given rectangle to [transparent black](#).

context.fillRect(x, y, w, h)

✓MDN

[CanvasRenderingContext2D/fillRect](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Paints the given rectangle onto the bitmap, using the current fill style.

context.strokeRect(x, y, w, h)

✓MDN

[CanvasRenderingContext2D/strokeRect](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Paints the box that outlines the given rectangle onto the bitmap, using the current stroke style.

The `clearRect(x, y, w, h)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. Let *pixels* be the set of pixels in the specified rectangle that also intersect the current [clipping region](#).
3. Clear the pixels in *pixels* to a [transparent black](#), erasing any previous image.

If either height or width are zero, this method has no effect, since the set of pixels would be empty.

The `fillRect(x, y, w, h)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. If either *w* or *h* are zero, then return.
3. Paint the specified rectangular area using [this's fill style](#).

The `strokeRect(x, y, w, h)` method, when invoked, must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. Take the result of [tracing the path](#) described below, using the [CanvasPathDrawingStyles](#) interface's line styles, and fill it with [this's stroke style](#).

If both *w* and *h* are zero, the path has a single subpath with just one point (*x, y*), and no lines, and this method thus has no effect (the [trace a path](#) algorithm returns an empty path in that case).

If just one of either *w* or *h* is zero, then the path has a single subpath consisting of two points, with coordinates (*x, y*) and (*x+w, y+h*), in that order, connected by a single straight line.

Otherwise, the path has a single subpath consisting of four points, with coordinates (*x, y*), (*x+w, y*), (*x+w, y+h*), and (*x, y+h*), connected to each other in that order by straight lines.

4.12.5.1.11 Drawing text to the bitmap



[CanvasRenderingContext2D](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android10.1+

context.fillText(text, x, y [, maxWidth])

✓MDN

[CanvasRenderingContext2D/fillText](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

context.strokeText(text, x, y [, maxWidth])

✓MDN

[CanvasRenderingContext2D/strokeText](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox AndroidYesSafari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Fills or strokes (respectively) the given text at the given position. If a maximum width is provided, the text will be scaled to fit that width if necessary.

metrics = context.measureText(text)

✓MDN

[CanvasRenderingContext2D/measureText](#)

Support in all current engines.

Firefox2+Safari4+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns a [TextMetrics](#) object with the metrics of the given text in the current font.

`metrics.width`

✓MDN

[TextMetrics/width](#)

Support in all current engines.

Firefox 1.5+ Safari 4+ Chrome 4+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 31+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android Yes

`metrics.actualBoundingBoxLeft`

✓MDN

[TextMetrics/actualBoundingBoxLeft](#)

Support in all current engines.

Firefox 74+ Safari 11.1+ Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11.3+ Chrome Android 77+ WebView Android 77+ Samsung

Internet 12.0+ Opera Android 55+

`metrics.actualBoundingBoxRight`

✓MDN

[TextMetrics/actualBoundingBoxRight](#)

Support in all current engines.

Firefox 74+ Safari 11.1+ Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11.3+ Chrome Android 77+ WebView Android 77+ Samsung

Internet 12.0+ Opera Android 55+

`metrics.fontBoundingBoxAscent`

✓MDN

[TextMetrics/fontBoundingBoxAscent](#)

Support in all current engines.

Firefox 74+ Safari 11.1+ Chrome 87+

Opera73+Edge87+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOS11.3+Chrome Android87+WebView Android87+Samsung Internet14.0+Opera AndroidNo

metrics.fontBoundingBoxDescent

✓MDN

[TextMetrics/fontBoundingBoxDescent](#)

Support in all current engines.

Firefox 74+Safari11.1+Chrome87+

Opera73+Edge87+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOS11.3+Chrome Android87+WebView Android87+Samsung Internet14.0+Opera AndroidNo

metrics.actualBoundingBoxAscent

✓MDN

[TextMetrics/actualBoundingBoxAscent](#)

Support in all current engines.

Firefox74+Safari11.1+Chrome77+

Opera64+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOS11.3+Chrome Android77+WebView Android77+Samsung Internet12.0+Opera Android55+

metrics.actualBoundingBoxDescent

✓MDN

[TextMetrics/actualBoundingBoxDescent](#)

Support in all current engines.

Firefox74+Safari11.1+Chrome77+

Opera64+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOS11.3+Chrome Android77+WebView Android77+Samsung Internet12.0+Opera Android55+

metrics.emHeightAscent

✓MDN

[TextMetrics/emHeightAscent](#)

Support in all current engines.

Firefox 74+ Safari 11.1+ Chrome 74+ Yes

Opera No Edge Yes

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11.3+ Chrome Android 74+ Yes WebView Android No Samsung

Internet No Opera Android No

metrics.emHeightDescent

MDN

[TextMetrics/emHeightDescent](#)

Support in all current engines.

Firefox 74+ Safari 11.1+ Chrome 74+ Yes

Opera No Edge Yes

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11.3+ Chrome Android 74+ Yes WebView Android No Samsung

Internet No Opera Android No

metrics.hangingBaseline

MDN

[TextMetrics/hangingBaseline](#)

Firefox 74+ Safari 11.1+ Chrome 35–70

Opera No Edge No

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11.3+ Chrome Android 35–70 WebView Android No Samsung

Internet No Opera Android No

metrics.alphabeticBaseline

MDN

[TextMetrics/alphabeticBaseline](#)

Firefox 74+ Safari 11.1+ Chrome 35–70

Opera No Edge No

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11.3+ Chrome Android 35–70 WebView Android No Samsung

Internet No Opera Android No

metrics.ideographicBaseline

MDN

[TextMetrics/ideographicBaseline](#)

Firefox 74+Safari 11.1+Chrome 35–70

Opera No Edge No

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS 11.3+ Chrome Android 35–70 WebView Android No Samsung Internet No Opera Android No

Returns the measurement described below.

Objects that implement the [CanvasText](#) interface provide the following methods for rendering text.

The *fillText(text, x, y, maxWidth)* and *strokeText(text, x, y, maxWidth)* methods render the given *text* at the given (x, y) coordinates ensuring that the text isn't wider than *maxWidth* if specified, using the current [font](#), [textAlign](#), and [textBaseline](#) values. Specifically, when the methods are invoked, the user agent must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. Run the [text preparation algorithm](#), passing it *text*, the object implementing the [CanvasText](#) interface, and, if the *maxWidth* argument was provided, that argument. Let *glyphs* be the result.
3. Move all the shapes in *glyphs* to the right by *x* [CSS pixels](#) and down by *y* [CSS pixels](#).
4. Paint the shapes given in *glyphs*, as transformed by the [current transformation matrix](#), with each [CSS pixel](#) in the coordinate space of *glyphs* mapped to one coordinate space unit.

For [fillText\(\)](#), *this*'s [fill style](#) must be applied to the shapes and *this*'s [stroke style](#) must be ignored. For [strokeText\(\)](#), the reverse holds: *this*'s [stroke style](#) must be applied to the result of [tracing](#) the shapes using the object implementing the [CanvasText](#) interface for the line styles, and *this*'s [fill style](#) must be ignored.

These shapes are painted without affecting the current path, and are subject to [shadow effects](#), [global alpha](#), the [clipping region](#), and [global composition operators](#).

(This
is a
tracking
vector.)

The *measureText(text)* method steps are to run the [text preparation algorithm](#), passing it *text* and the object implementing the [CanvasText](#) interface, and then using the returned [inline box](#) must return a new [TextMetrics](#) object with members behaving as described in the following list: [\[CSS\]](#)

width attribute

The width of that [inline box](#), in [CSS pixels](#). (The text's advance width.)

actualBoundingBoxLeft attribute

The distance parallel to the baseline from the alignment point given by the [textAlign](#) attribute to the left side of the bounding rectangle of the given text, in [CSS pixels](#); positive numbers indicating a distance going left from the given alignment point.

The sum of this value and the next ([*actualBoundingBoxRight*](#)) can be wider than the width of the [inline box](#) ([width](#)), in particular with slanted fonts where characters overhang their advance width.

actualBoundingBoxRight attribute

The distance parallel to the baseline from the alignment point given by the [textAlign](#) attribute to the right side of the bounding rectangle of the given text, in [CSS pixels](#); positive numbers indicating a distance going right from the given alignment point.

fontBoundingBoxAscent attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the [ascent metric](#) of the [first available font](#), in [CSS pixels](#); positive numbers indicating a distance going up from the given baseline.

This value and the next are useful when rendering a background that have to have a consistent height even if the exact text being rendered changes. The [*actualBoundingBoxAscent*](#) attribute (and its corresponding attribute for the descent) are useful when drawing a bounding box around specific text.

fontBoundingBoxDescent attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the [descent metric](#) of the [first available font](#), in [CSS pixels](#); positive numbers indicating a distance going down from the given baseline.

actualBoundingBoxAscent attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the top of the bounding rectangle of the given text, in [CSS pixels](#); positive numbers indicating a distance going up from the given baseline.

This number can vary greatly based on the input text, even if the first font specified covers all the characters in the input. For example, the [*actualBoundingBoxAscent*](#) of a lowercase "o" from an [alphabetic baseline](#) would be less than that of an uppercase "F". The value can easily be negative; for example, the distance from the top of the em box ([textBaseline](#) value "[top](#)") to the top of the bounding rectangle when the given text is just a single comma "," would likely (unless the font is quite unusual) be negative.

actualBoundingBoxDescent attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the bottom of the bounding rectangle of the given text, in [CSS pixels](#); positive numbers indicating a distance going down from the given baseline.

emHeightAscent attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the highest top of the em squares in the [inline box](#), in [CSS pixels](#); positive numbers indicating that the given baseline is below the top of that em square (so this value will usually be positive). Zero if the given baseline is the top of that em square; half the font size if the given baseline is the middle of that em square.

emHeightDescent attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the lowest bottom of the em squares in the [inline box](#), in [CSS pixels](#); positive numbers indicating that the given baseline is above the bottom of that em square. (Zero if the given baseline is the bottom of that em square.)

hangingBaseline attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the [hanging baseline](#) of the [inline box](#), in [CSS pixels](#); positive numbers indicating that the given baseline is below the [hanging baseline](#). (Zero if the given baseline is the [hanging baseline](#).)

alphabeticBaseline attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the [alphabetic baseline](#) of the [inline box](#), in [CSS pixels](#); positive numbers indicating that the given baseline is below the [alphabetic baseline](#). (Zero if the given baseline is the [alphabetic baseline](#).)

ideographicBaseline attribute

The distance from the horizontal line indicated by the [textBaseline](#) attribute to the [ideographic-under baseline](#) of the [inline box](#), in [CSS pixels](#); positive numbers indicating that the given baseline is below the [ideographic-under baseline](#). (Zero if the given baseline is the [ideographic-under baseline](#).)

Glyphs rendered using [fillText\(\)](#) and [strokeText\(\)](#) can spill out of the box given by the font size (the em square size) and the width returned by [measureText\(\)](#) (the text width). Authors are encouraged to use the bounding box values described above if this is an issue.

A future version of the 2D context API might provide a way to render fragments of documents, rendered using CSS, straight to the canvas. This would be provided in preference to a dedicated

way of doing multiline layout.

4.12.5.1.12 Drawing paths to the canvas

Objects that implement the [CanvasDrawPath](#) interface have a *current default path*. There is only one current default path, it is not part of the drawing state. The current default path is a path, as described above.

`context.beginPath()`

✓MDN

[CanvasRenderingContext2D/beginPath](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Resets the current default path.

`context.fill([fillRule])`

✓MDN

[CanvasRenderingContext2D/fill](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

`context.fill(path [, fillRule])`

Fills the subpaths of the current default path or the given path with the current fill style, obeying the given fill rule.

`context.stroke()`

✓MDN

[CanvasRenderingContext2D/stroke](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

context.stroke(path)

Strokes the subpaths of the [current default path](#) or the given path with the current stroke style.

context.clip([fillRule])

✓MDN

[CanvasRenderingContext2D/clip](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

context.clip(path [, fillRule])

Further constrains the clipping region to the [current default path](#) or the given path, using the given fill rule to determine what points are in the path.

context.isPointInPath(x, y [, fillRule])

✓MDN

[CanvasRenderingContext2D/isPointInPath](#)

Support in all current engines.

Firefox 2+ Safari 3.1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

context.isPointInPath(path, x, y [, fillRule])

Returns true if the given point is in the [current default path](#) or the given path, using the given fill rule to determine what points are in the path.

`context.isPointInStroke(x, y)`

✓MDN

[CanvasRenderingContext2D/isPointInStroke](#)

Support in all current engines.

Firefox 20+ Safari 7+ Chrome 26+

Opera 15+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 20+ Safari iOS 7+ Chrome Android 26+ WebView Android 37+ Samsung

Internet 1.5+ Opera Android 14+

`context.isPointInStroke(path, x, y)`

Returns true if the given point would be in the region covered by the stroke of the [current default path](#) or the given path, given the current stroke style.

The `beginPath()` method steps are to empty the list of subpaths in `this`'s [current default path](#) so that it once again has zero subpaths.

Where the following method definitions use the term *intended path* for a [Path2D](#)-or-null *path*, it means *path* itself if it is a [Path2D](#) object, or the [current default path](#) otherwise.

When the [intended path](#) is a [Path2D](#) object, the coordinates and lines of its subpaths must be transformed according to the [current transformation matrix](#) on the object implementing the [CanvasTransform](#) interface when used by these methods (without affecting the [Path2D](#) object itself). When the intended path is the [current default path](#), it is not affected by the transform. (This is because transformations already affect the [current default path](#) when it is constructed, so applying it when it is painted as well would result in a double transformation.)

The `fill(fillRule)` method steps are to run the [fill steps](#) given `this`, null, and *fillRule*.

The `fill(path, fillRule)` method steps are to run the [fill steps](#) given `this`, *path*, and *fillRule*.

The *fill steps*, given a [CanvasDrawPath](#) context, a [Path2D](#)-or-null *path*, and a [fill rule](#) *fillRule*, are to fill all the subpaths of the [intended path](#) for *path*, using `context`'s [fill style](#), and using the [fill rule](#) indicated by *fillRule*. Open subpaths must be implicitly closed when being filled (without affecting the actual subpaths).

The `stroke()` method steps are to run the [stroke steps](#) given `this` and null.

The `stroke(path)` method steps are to run the [stroke steps](#) given `this` and *path*.

The *stroke steps*, given a [CanvasDrawPath](#) context and a [Path2D](#)-or-null *path*, are to [trace](#) the [intended path](#) for *path*, using `context`'s line styles as set by its

[CanvasPathDrawingStyles](#) mixin, and then fill the resulting path using *context's stroke style*, using the [nonzero winding rule](#).

As a result of how the algorithm to [trace a path](#) is defined, overlapping parts of the paths in one stroke operation are treated as if their union was what was painted.

The stroke *style* is affected by the transformation during painting, even if the [current default path](#) is used.

Paths, when filled or stroked, must be painted without affecting the [current default path](#) or any [Path2D](#) objects, and must be subject to [shadow effects](#), [global alpha](#), the [clipping region](#), and [global composition operators](#). (The effect of transformations is described above and varies based on which path is being used.)

The *clip(fillRule)* method steps are to run the [clip steps](#) given [this](#), null, and *fillRule*.

The *clip(path, fillRule)* method steps are to run the [clip steps](#) given [this](#), *path*, and *fillRule*.

The *clip steps*, given a [CanvasDrawPath](#) context, a [Path2D](#)-or-null *path*, and a [fill rule](#) *fillRule*, are to create a new *clipping region* by calculating the intersection of *context's current clipping region* and the area described by the [intended path](#) for *path*, using the [fill rule](#) indicated by *fillRule*. Open subpaths must be implicitly closed when computing the clipping region, without affecting the actual subpaths. The new clipping region replaces the current clipping region.

When the context is initialized, its current clipping region must be set to the largest infinite surface (i.e. by default, no clipping occurs).

The *isPointInPath(x, y, fillRule)* method steps are to return the result of the [is point in path steps](#) given [this](#), null, *x*, *y*, and *fillRule*.

The *isPointInPath(path, x, y, fillRule)* method steps are to return the result of the [is point in path steps](#) given [this](#), null, *x*, *y*, and *fillRule*.

The *is point in path steps*, given a [CanvasDrawPath](#) context, a [Path2D](#)-or-null *path*, two numbers *x* and *y*, and a [fill rule](#) *fillRule*, are:

1. If *x* or *y* are infinite or NaN, then return false.
2. If the point given by the *x* and *y* coordinates, when treated as coordinates in the canvas coordinate space unaffected by the current transformation, is inside the [intended path](#) for *path* as determined by the [fill rule](#) indicated by *fillRule*, then return true. Open subpaths must be implicitly closed when computing the area inside the path, without affecting the actual subpaths. Points on the path itself must be considered to be inside

the path.

3. Return false.
-

The `isPointInStroke(x, y)` method steps are to return the result of the [is point in stroke steps](#) given `this`, null, `x`, and `y`.

The `isPointInStroke(path, x, y)` method steps are to return the result of the [is point in stroke steps](#) given `this`, `path`, `x`, and `y`.

The *is point in stroke steps*, given a [CanvasDrawPath](#) context, a [Path2D](#)-or-null `path`, and two numbers `x` and `y`, are:

1. If `x` or `y` are infinite or NaN, then return false.
 2. If the point given by the `x` and `y` coordinates, when treated as coordinates in the canvas coordinate space unaffected by the current transformation, is inside the path that results from [tracing](#) the [intended path](#) for `path`, using the [nonzero winding rule](#), and using `context`'s line styles as set by its [CanvasPathDrawingStyles](#) mixin, then return true. Points on the resulting path must be considered to be inside the path.
 3. Return false.
-

This [canvas](#) element has a couple of checkboxes. The path-related commands are highlighted:

```
<canvas height=400 width=750>
  <label><input type=checkbox id=showA> Show As</label>
  <label><input type=checkbox id=showB> Show Bs</label>
  <!-- ... -->
</canvas>
<script>
  function drawCheckbox(context, element, x, y, paint) {
    context.save();
    context.font = '10px sans-serif';
    context.textAlign = 'left';
    context.textBaseline = 'middle';
    var metrics = context.measureText(element.labels[0].textContent);
    if (paint) {
      context.beginPath();
      context.strokeStyle = 'black';
      context.rect(x-5, y-5, 10, 10);
      context.stroke();
      if (element.checked) {
        context.fillStyle = 'black';
        context.fill();
```

```

        }
        context.fillText(element.labels[0].textContent, x+5, y);
    }
context.beginPath();
context.rect(x-7, y-7, 12 + metrics.width+2, 14);

    context.drawFocusIfNeeded(element);
    context.restore();
}
function drawBase() { /* ... */ }
function drawAs() { /* ... */ }
function drawBs() { /* ... */ }
function redraw() {
    var canvas = document.getElementsByTagName('canvas')[0];
    var context = canvas.getContext('2d');
    context.clearRect(0, 0, canvas.width, canvas.height);
    drawCheckbox(context, document.getElementById('showA'), 20, 40, true);
    drawCheckbox(context, document.getElementById('showB'), 20, 60, true);
    drawBase();
    if (document.getElementById('showA').checked)
        drawAs();
    if (document.getElementById('showB').checked)
        drawBs();
}
function processClick(event) {
    var canvas = document.getElementsByTagName('canvas')[0];
    var context = canvas.getContext('2d');
    var x = event.clientX;
    var y = event.clientY;
    var node = event.target;
    while (node) {
        x -= node.offsetLeft - node.scrollLeft;
        y -= node.offsetTop - node.scrollTop;
        node = node.offsetParent;
    }
    drawCheckbox(context, document.getElementById('showA'), 20, 40, false);
    if (context.isPointInPath(x, y))
        document.getElementById('showA').checked = !(document.getElementById('sh
    drawCheckbox(context, document.getElementById('showB'), 20, 60, false);
    if (context.isPointInPath(x, y))
        document.getElementById('showB').checked = !(document.getElementById('sh
    redraw();
}
document.getElementsByTagName('canvas')[0].addEventListener('focus', redraw,
document.getElementsByTagName('canvas')[0].addEventListener('blur', redraw,
document.getElementsByTagName('canvas')[0].addEventListener('change', redraw,
document.getElementsByTagName('canvas')[0].addEventListener('click', process

```

```
redraw();
</script>
```

4.12.5.1.13 Drawing focus rings and scrolling paths into view

`context.drawFocusIfNeeded(element)`

✓MDN

[CanvasRenderingContext2D/drawFocusIfNeeded](#)

Support in all current engines.

Firefox 32+ Safari 8+ Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) 14+ Internet Explorer No

Firefox Android 32+ Safari iOS 8+ Chrome Android 37+ WebView Android 37+ Samsung

Internet 3.0+ Opera Android 24+

`context.drawFocusIfNeeded(path, element)`

If the given element is [focused](#), draws a focus ring around the [current default path](#) or the given path, following the platform conventions for focus rings.

`context.scrollPathIntoView()`

⚠MDN

[CanvasRenderingContext2D/scrollPathIntoView](#)

Support in one engine only.

Firefox No Safari No Chrome 36+

Opera 23+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 36+ WebView Android No Samsung

Internet No Opera Android No

`context.scrollPathIntoView(path)`

Scrolls the [current default path](#) or the given path into view. This is especially useful on devices with small screens, where the whole canvas might not be visible at once.

Objects that implement the [CanvasUserInterface](#) interface provide the following methods to control drawing focus rings and scrolling paths into view.

The `drawFocusIfNeeded(element)` method, when invoked, must run these steps:

1. If `element` is not [focused](#) or is not a descendant of the element with whose context the

method is associated, then return.

2. Draw a focus ring of the appropriate style along the intended path, following platform conventions.

Some platforms only draw focus rings around elements that have been focused from the keyboard, and not those focused from the mouse. Other platforms simply don't draw focus rings around some elements at all unless relevant accessibility features are enabled. This API is intended to follow these conventions. User agents that implement distinctions based on the manner in which the element was focused are encouraged to classify focus driven by the [focus\(\)](#) method based on the kind of user interaction event from which the call was triggered (if any).

The focus ring should not be subject to the [shadow effects](#), the [global alpha](#), the [global composition operators](#), or any of the members in the [CanvasFillStrokeStyles](#), [CanvasPathDrawingStyles](#), [CanvasTextDrawingStyles](#) interfaces, but *should* be subject to the [clipping region](#). (The effect of transformations is described above and varies based on which path is being used.)

3. [Inform the user](#) that the focus is at the location given by the intended path. User agents may wait until the next time the [event loop](#) reaches its [update the rendering](#) step to optionally inform the user.

User agents should not implicitly close open subpaths in the intended path when drawing the focus ring.

This might be a moot point, however. For example, if the focus ring is drawn as an axis-aligned bounding rectangle around the points in the intended path, then whether the subpaths are closed or not has no effect. This specification intentionally does not specify precisely how focus rings are to be drawn: user agents are expected to honor their platform's native conventions.

The [scrollPathIntoView\(\)](#) method, when invoked, must run these steps:

1. Let *specifiedRectangle* be the rectangle of the bounding box of the intended path.
2. Let *notionalChild* be a hypothetical element that is a rendered child of the [canvas](#) element whose dimensions are those of *specifiedRectangle*.
3. [Scroll *notionalChild* into view](#) with *behavior* set to "auto", *block* set to "start", and *inline* set to "nearest".
4. Optionally, [inform the user](#) that the caret or selection (or both) cover *specifiedRectangle* of the canvas. The user agent may wait until the next time the [event loop](#) reaches its [update the rendering](#) step to optionally inform the user.

"Inform the user", as used in this section, does not imply any persistent state change. It could mean, for instance, calling a system accessibility API to notify assistive technologies such as

magnification tools so that the user's magnifier moves to the given area of the canvas. However, it does not associate the path with the element, or provide a region for tactile feedback, etc.

4.12.5.1.14 Drawing images

Objects that implement the [CanvasDrawImage](#) interface have the *drawImage* method to draw images.

This method can be invoked with three different sets of arguments:

- `drawImage(image, dx, dy)`
- `drawImage(image, dx, dy, dw, dh)`
- `drawImage(image, sx, sy, sw, sh, dx, dy, dw, dh)`

`context.drawImage(image, dx, dy)`

✓MDN

[CanvasRenderingContext2D/drawImage](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

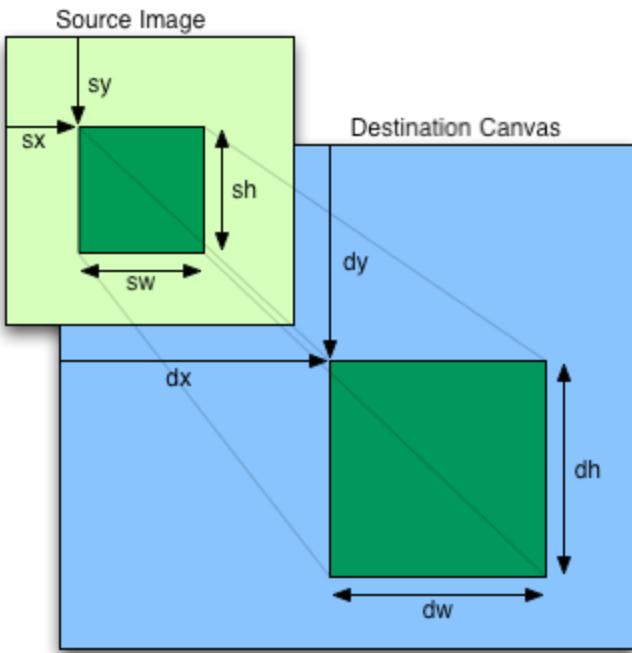
Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

`context.drawImage(image, dx, dy, dw, dh)`

`context.drawImage(image, sx, sy, sw, sh, dx, dy, dw, dh)`

Draws the given image onto the canvas. The arguments are interpreted as follows:



If the image isn't yet fully decoded, then nothing is drawn. If the image is a canvas with no data, throws an ["InvalidStateError" DOMException](#).

When the [drawImage\(\)](#) method is invoked, the user agent must run these steps:

1. If any of the arguments are infinite or NaN, then return.
2. Let *usability* be the result of [checking the usability of *image*](#).
3. If *usability* is *bad*, then return (without drawing anything).
4. Establish the source and destination rectangles as follows:

If not specified, the *dw* and *dh* arguments must default to the values of *sw* and *sh*, interpreted such that one [CSS pixel](#) in the image is treated as one unit in the [output bitmap](#)'s coordinate space. If the *sx*, *sy*, *sw*, and *sh* arguments are omitted, then they must default to 0, 0, the image's [intrinsic width](#) in image pixels, and the image's [intrinsic height](#) in image pixels, respectively. If the image has no [intrinsic dimensions](#), then the *concrete object size* must be used instead, as determined using the CSS ["Concrete Object Size Resolution"](#) algorithm, with the *specified size* having neither a definite width nor height, nor any additional constraints, the object's intrinsic properties being those of the *image* argument, and the [default object size](#) being the size of the [output bitmap](#). [\[CSSIMAGES\]](#)

The source rectangle is the rectangle whose corners are the four points (sx, sy) , $(sx+sw, sy)$, $(sx+sw, sy+sh)$, $(sx, sy+sh)$.

The destination rectangle is the rectangle whose corners are the four points (dx, dy) ,

$(dx+dw, dy), (dx+dw, dy+dh), (dx, dy+dh)$.

When the source rectangle is outside the source image, the source rectangle must be clipped to the source image and the destination rectangle must be clipped in the same proportion.

When the destination rectangle is outside the destination image (the [output bitmap](#)), the pixels that land outside the [output bitmap](#) are discarded, as if the destination was an infinite canvas whose rendering was clipped to the dimensions of the [output bitmap](#).

5. If one of the *sw* or *sh* arguments is zero, then return. Nothing is painted.
6. Paint the region of the *image* argument specified by the source rectangle on the region of the rendering context's [output bitmap](#) specified by the destination rectangle, after applying the [current transformation matrix](#) to the destination rectangle.

The image data must be processed in the original direction, even if the dimensions given are negative.

When scaling up, if the [imageSmoothingEnabled](#) attribute is set to true, the user agent should attempt to apply a smoothing algorithm to the image data when it is scaled. User agents which support multiple filtering algorithms may use the value of the [imageSmoothingQuality](#) attribute to guide the choice of filtering algorithm when the [imageSmoothingEnabled](#) attribute is set to true. Otherwise, the image must be rendered using nearest-neighbor interpolation.

This specification does not define the precise algorithm to use when scaling an image down, or when scaling an image up when the [imageSmoothingEnabled](#) attribute is set to true.

When a [canvas](#) element is drawn onto itself, the [drawing model](#) requires the source to be copied before the image is drawn, so it is possible to copy parts of a [canvas](#) element onto overlapping parts of itself.

If the original image data is a bitmap image, then the value painted at a point in the destination rectangle is computed by filtering the original image data. The user agent may use any filtering algorithm (for example bilinear interpolation or nearest-neighbor). When the filtering algorithm requires a pixel value from outside the original image data, it must instead use the value from the nearest edge pixel. (That is, the filter uses 'clamp-to-edge' behavior.) When the filtering algorithm requires a pixel value from outside the source rectangle but inside the original image data, then the value from the original image data must be used.

Thus, scaling an image in parts or in whole will have the same effect. This does mean that when sprites coming from a single sprite sheet are to be scaled, adjacent images in the sprite sheet can interfere. This can be avoided by ensuring each sprite in the sheet is surrounded by a border of [transparent black](#), or by copying sprites to be scaled into

temporary [canvas](#) elements and drawing the scaled sprites from there.

Images are painted without affecting the current path, and are subject to [shadow effects](#), [global alpha](#), the [clipping region](#), and [global composition operators](#).

7. If *image* is not origin-clean, then set the [CanvasRenderingContext2D](#)'s origin-clean flag to false.

4.12.5.1.15 Pixel manipulation

`imagedata = new ImageData(sw, sh [, settings])`

✓MDN

[ImageData](#)/[ImageData](#)

Support in all current engines.

Firefox29+Safari7+Chrome42+

Opera29+Edge79+

Edge (Legacy)14+Internet ExplorerNo

Firefox Android29+Safari iOS7+Chrome Android42+WebView AndroidNoSamsung

Internet4.0+Opera Android?

Returns an [ImageData](#) object with the given dimensions and the color space indicated by *settings*. All the pixels in the returned object are [transparent black](#).

Throws an ["IndexSizeError"](#) [DOMException](#) if either of the width or height arguments are zero.

`imagedata = new ImageData(data, sw [, sh [, settings]])`

Returns an [ImageData](#) object using the data provided in the [Uint8ClampedArray](#) argument, interpreted using the given dimensions and the color space indicated by *settings*.

As each pixel in the data is represented by four numbers, the length of the data needs to be a multiple of four times the given width. If the height is provided as well, then the length needs to be exactly the width times the height times 4.

Throws an ["IndexSizeError"](#) [DOMException](#) if the given data and dimensions can't be interpreted consistently, or if either dimension is zero.

`imagedata = context.createImageData(imagedata)`

Returns an [ImageData](#) object with the same dimensions and color space as the argument. All the pixels in the returned object are [transparent black](#).

`imagedata = context.createImageData(sw, sh [, settings])`

✓MDN

[CanvasRenderingContext2D/createImageData](#)

Support in all current engines.

Firefox 2+ Safari 4+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns an [ImageData](#) object with the given dimensions. The color space of the returned object is the [color space](#) of *context* unless overridden by *settings*. All the pixels in the returned object are [transparent black](#).

Throws an ["IndexSizeError" DOMException](#) if either of the width or height arguments are zero.

`imagedata = context.getImageData(sx, sy, sw, sh [, settings])`

✓MDN

[CanvasRenderingContext2D/getImageData](#)

Support in all current engines.

Firefox 2+ Safari 4+ Chrome 1+

Opera 9.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns an [ImageData](#) object containing the image data for the given rectangle of the bitmap. The color space of the returned object is the [color space](#) of *context* unless overridden by *settings*.

Throws an ["IndexSizeError" DOMException](#) if the either of the width or height arguments are zero.

`imagedata.width`

✓MDN

[ImageData/width](#)

Support in all current engines.

Firefox 14+ Safari 3.1+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 14+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

imagedata.height

✓MDN

[ImageData/height](#)

Support in all current engines.

Firefox 14+ Safari 3.1+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 14+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns the actual dimensions of the data in the [ImageData](#) object, in pixels.

imagedata.data

✓MDN

[ImageData/data](#)

Support in all current engines.

Firefox 14+ Safari 3.1+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 14+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns the one-dimensional array containing the data in RGBA order, as integers in the range 0 to 255.

imagedata.colorSpace

Returns the color space of the pixels.

`context.putImageData(imagedata, dx, dy [, dirtyX, dirtyY, dirtyWidth, dirtyHeight])`

✓MDN

[CanvasRenderingContext2D/putImageData](#)

Support in all current engines.

Firefox 2+ Safari 4+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Paints the data from the given [ImageData](#) object onto the bitmap. If a dirty rectangle is provided, only the pixels from that rectangle are painted.

The [globalAlpha](#) and [globalCompositeOperation](#) attributes, as well as the shadow attributes, are ignored for the purposes of this method call; pixels in the canvas are replaced wholesale, with no composition, alpha blending, no shadows, etc.

Throws an ["InvalidStateError" DOMException](#) if the `imagedata` object's [data](#) attribute value's `[[ViewedArrayBuffer]]` internal slot is detached.

Objects that implement the [CanvasImageData](#) interface provide the following methods for reading and writing pixel data to the bitmap.

The `new ImageData(sw, sh, settings)` constructor steps are:

1. If one or both of `sw` and `sh` are zero, then throw an ["IndexSizeError" DOMException](#).
2. [Initialize this](#) given `sw`, `sh`, and `settings` set to `settings`.
3. Initialize the image data of [this](#) to [transparent black](#).

The `new ImageData(data, sw, sh, settings)` constructor steps are:

1. Let `length` be the number of bytes in `data`.
2. If `length` is not a nonzero integral multiple of four, then throw an ["InvalidStateError" DOMException](#).
3. Let `length` be `length` divided by four.
4. If `length` is not an integral multiple of `sw`, then throw an ["IndexSizeError" DOMException](#).

At this step, the length is guaranteed to be greater than zero (otherwise the second step above would have aborted the steps), so if `sw` is zero, this step will throw the exception and return.

5. Let *height* be *length* divided by *sw*.
6. If *sh* was given and its value is not equal to *height*, then throw an "[IndexSizeError](#)" [DOMException](#).
7. [Initialize this](#) given *sw*, *sh*, *settings* set to *settings*, and *source* set to *data*.

This step does not set [*this*](#)'s data to a copy of *data*. It sets it to the actual [Uint8ClampedArray](#) object passed as *data*.

The *createImageData(sw, sh, settings)* method steps are:

1. If one or both of *sw* and *sh* are zero, then throw an "[IndexSizeError](#)" [DOMException](#).
2. Let *newImageData* be a [new ImageData](#) object.
3. [Initialize](#) *newImageData* given the absolute magnitude of *sw*, the absolute magnitude of *sh*, *settings* set to *settings*, and *defaultColorSpace* set to [*this*](#)'s [color space](#).
4. Initialize the image data of *newImageData* to [transparent black](#).
5. Return *newImageData*.

The *createImageData(imagedata)* method steps are:

1. Let *newImageData* be a [new ImageData](#) object.
2. [Initialize](#) *newImageData* given the value of *imagedata*'s [width](#) attribute, the value of *imagedata*'s [height](#) attribute, and *defaultColorSpace* set to the value of *imagedata*'s [colorSpace](#) attribute.
3. Initialize the image data of *newImageData* to [transparent black](#).
4. Return *newImageData*.

The *getImageData(sx, sy, sw, sh, settings)* method steps are:

1. If either the *sw* or *sh* arguments are zero, then throw an "[IndexSizeError](#)" [DOMException](#).
2. If the [CanvasRenderingContext2D](#)'s [origin-clean](#) flag is set to false, then throw a "[SecurityError](#)" [DOMException](#).
3. Let *imageData* be a [new ImageData](#) object.
4. [Initialize](#) *imageData* given *sw*, *sh*, *settings* set to *settings*, and *defaultColorSpace* set to

[this's color space](#).

5. Let the source rectangle be the rectangle whose corners are the four points (sx, sy) , $(sx+sw, sy)$, $(sx+sw, sy+sh)$, $(sx, sy+sh)$.
6. Set the pixel values of *imageData* to be the pixels of [this's output bitmap](#) in the area specified by the source rectangle in the bitmap's coordinate space units, converted from [this's color space](#) to *imageData*'s [colorSpace](#) using '[relative-colorimetric](#)' rendering intent.
7. Set the pixels values of *imageData* for areas of the source rectangle that are outside of the [output bitmap](#) to [transparent black](#).
8. Return *imageData*.

To initialize an [ImageData](#) object *imageData*, given a positive integer number of rows *rows*, a positive integer number of pixels per row *pixelsPerRow*, an optional [ImageDataSettings](#) *settings*, an optional [Uint8ClampedArray](#) *source*, and an optional [PredefinedColorSpace](#) *defaultColorSpace*:

1. If *source* was given, then initialize the [data](#) attribute of *imageData* to *source*.
2. Otherwise (*source* was not given), initialize the [data](#) attribute of *imageData* to a new [Uint8ClampedArray](#) object. The [Uint8ClampedArray](#) object must use a new [Canvas Pixel ArrayBuffer](#) for its storage, and must have a zero start offset and a length equal to the length of its storage, in bytes. The [Canvas Pixel ArrayBuffer](#) must have the correct size to store *rows* \times *pixelsPerRow* pixels.

If the [Canvas Pixel ArrayBuffer](#) cannot be allocated, then rethrow the [RangeError](#) thrown by JavaScript, and return.

3. Initialize the [width](#) attribute of *imageData* to *pixelsPerRow*.
4. Initialize the [height](#) attribute of *imageData* to *rows*.
5. If *settings* was given and *settings*[[colorSpace](#)] [exists](#), then initialize the [colorSpace](#) attribute of *imageData* to *settings*[[colorSpace](#)].
6. Otherwise, if *defaultColorSpace* was given, then initialize the [colorSpace](#) attribute of *imageData* to *defaultColorSpace*.
7. Otherwise, initialize the [colorSpace](#) attribute of *imageData* to "[srgb](#)".

[ImageData](#) objects are [serializable objects](#). Their [serialization steps](#), given *value* and *serialized*, are:

1. Set *serialized*.[[[Data](#)]] to the [sub-serialization](#) of the value of *value*'s [data](#) attribute.

2. Set `serialized.[[Width]]` to the value of `value`'s `width` attribute.
3. Set `serialized.[[Height]]` to the value of `value`'s `height` attribute.
4. Set `serialized.[[ColorSpace]]` to the value of `value`'s `colorSpace` attribute.

Their [deserialization steps](#), given `serialized` and `value`, are:

1. Initialize `value`'s `data` attribute to the [sub-deserialization](#) of `serialized.[[Data]]`.
2. Initialize `value`'s `width` attribute to `serialized.[[Width]]`.
3. Initialize `value`'s `height` attribute to `serialized.[[Height]]`.
4. Initialize `value`'s `colorSpace` attribute to `serialized.[[ColorSpace]]`.

A *Canvas Pixel ArrayBuffer* is an [ArrayBuffer](#) whose data is represented in left-to-right order, row by row top to bottom, starting with the top left, with each pixel's red, green, blue, and alpha components being given in that order for each pixel. Each component of each pixel represented in this array must be in the range 0..255, representing the 8 bit value for that component. The components must be assigned consecutive indices starting with 0 for the top left pixel's red component.

The `putImageData()` method writes data from [ImageData](#) structures back to the rendering context's [output bitmap](#). Its arguments are: `imagedata`, `dx`, `dy`, `dirtyX`, `dirtyY`, `dirtyWidth`, and `dirtyHeight`.

When the last four arguments to this method are omitted, they must be assumed to have the values 0, 0, the `width` member of the `imagedata` structure, and the `height` member of the `imagedata` structure, respectively.

The method, when invoked, must act as follows:

1. Let `buffer` be `imagedata`'s `data` attribute value's `[ViewedArrayBuffer]` internal slot.
2. If [`IsDetachedBuffer\(buffer\)`](#) is true, then throw an [`"InvalidStateError"` `DOMException`](#).
3. If `dirtyWidth` is negative, then let `dirtyX` be `dirtyX+dirtyWidth`, and let `dirtyWidth` be equal to the absolute magnitude of `dirtyWidth`.

If `dirtyHeight` is negative, then let `dirtyY` be `dirtyY+dirtyHeight`, and let `dirtyHeight` be equal to the absolute magnitude of `dirtyHeight`.

4. If `dirtyX` is negative, then let `dirtyWidth` be `dirtyWidth+dirtyX`, and let `dirtyX` be zero.
- If `dirtyY` is negative, then let `dirtyHeight` be `dirtyHeight+dirtyY`, and let `dirtyY` be zero.

5. If $\text{dirtyX} + \text{dirtyWidth}$ is greater than the [width](#) attribute of the *imagedata* argument, then let *dirtyWidth* be the value of that [width](#) attribute, minus the value of *dirtyX*.

If $\text{dirtyY} + \text{dirtyHeight}$ is greater than the [height](#) attribute of the *imagedata* argument, then let *dirtyHeight* be the value of that [height](#) attribute, minus the value of *dirtyY*.

6. If, after those changes, either *dirtyWidth* or *dirtyHeight* are negative or zero, then return without affecting any bitmaps.
7. For all integer values of *x* and *y* where $\text{dirtyX} \leq x < \text{dirtyX} + \text{dirtyWidth}$ and $\text{dirtyY} \leq y < \text{dirtyY} + \text{dirtyHeight}$, copy the four channels of the pixel with coordinate (x, y) in the *imagedata* data structure's [Canvas Pixel ArrayBuffer](#) to the pixel with coordinate $(dx+x, dy+y)$ in the rendering context's [output bitmap](#).

Due to the lossy nature of converting between color spaces and converting to and from [premultiplied alpha](#) color values, pixels that have just been set using [putImageData\(\)](#), and are not completely opaque, might be returned to an equivalent [getImageData\(\)](#) as different values.

The current path, [transformation matrix](#), [shadow attributes](#), [global alpha](#), the [clipping region](#), and [global composition operator](#) must not affect the methods described in this section.

In the following example, the script generates an [ImageData](#) object so that it can draw onto it.

```
// canvas is a reference to a <canvas> element
var context = canvas.getContext('2d');

// create a blank slate
var data = context.createImageData(canvas.width, canvas.height);

// create some plasma
FillPlasma(data, 'green'); // green plasma

// add a cloud to the plasma
AddCloud(data, data.width/2, data.height/2); // put a cloud in the middle

// paint the plasma+cloud on the canvas
context.putImageData(data, 0, 0);

// support methods
function FillPlasma(data, color) { ... }
function AddCloud(data, x, y) { ... }
```

Here is an example of using [getImageData\(\)](#) and [putImageData\(\)](#) to implement an edge detection filter.

```
<!DOCTYPE HTML>
<html lang="en">
<head>
  <title>Edge detection demo</title>
  <script>
    var image = new Image();
    function init() {
      image.onload = demo;
      image.src = "image.jpeg";
    }
    function demo() {
      var canvas = document.getElementsByTagName('canvas')[0];
      var context = canvas.getContext('2d');

      // draw the image onto the canvas
      context.drawImage(image, 0, 0);

      // get the image data to manipulate
      var input = context.getImageData(0, 0, canvas.width, canvas.height);

      // get an empty slate to put the data into
      var output = context.createImageData(canvas.width, canvas.height);

      // alias some variables for convenience
      // In this case input.width and input.height
      // match canvas.width and canvas.height
      // but we'll use the former to keep the code generic.
      var w = input.width, h = input.height;
      var inputData = input.data;
      var outputData = output.data;

      // edge detection
      for (var y = 1; y < h-1; y += 1) {
        for (var x = 1; x < w-1; x += 1) {
          for (var c = 0; c < 3; c += 1) {
            var i = (y*w + x)*4 + c;
            outputData[i] = 127 + -inputData[i - w*4 - 4] - inputData[i - w*4 + 4] + 8*inputData[i] - inputData[i + w*4 - 4] - inputData[i + w*4 + 4];
          }
          outputData[(y*w + x)*4 + 3] = 255; // alpha
        }
      }

      // put the image data back after manipulation
      context.putImageData(output, 0, 0);
    }
  </script>

```

```
</script>
</head>
<body onload="init()">
  <canvas></canvas>
</body>
</html>
```

Here is an example of color space conversion applied when drawing a solid color and reading the result back using and [getImageData\(\)](#).

```
<!DOCTYPE HTML>
<html lang="en">
<title>Color space image data demo</title>

<canvas></canvas>

<script>
const canvas = document.querySelector('canvas');
const context = canvas.getContext('2d', {colorSpace:'display-p3'});

// Draw a red rectangle. Note that the hex color notation
// specifies sRGB colors.
context.fillStyle = "#FF0000";
context.fillRect(0, 0, 64, 64);

// Get the image data.
const pixels = context.getImageData(0, 0, 1, 1);

// This will print 'display-p3', reflecting the default behavior
// of returning image data in the canvas's color space.
console.log(pixels.colorSpace);

// This will print the values 234, 51, and 35, reflecting the
// red fill color, converted to 'display-p3'.
console.log(pixels.data[0]);
console.log(pixels.data[1]);
console.log(pixels.data[2]);
</script>
```

4.12.5.1.16 Compositing

context.globalAlpha [= value]

✓MDN

[CanvasRenderingContext2D/globalAlpha](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns the current alpha value applied to rendering operations.

Can be set, to change the alpha value. Values outside of the range 0.0 .. 1.0 are ignored.

`context.globalCompositeOperation [= value]`

✓MDN

[CanvasRenderingContext2D/globalCompositeOperation](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns the current composition operation, from the values defined in *Compositing and Blending*. [\[COMPOSITE\]](#).

Can be set, to change the composition operation. Unknown values are ignored.

All drawing operations on an object which implements the [CanvasCompositing](#) interface are affected by the global compositing attributes, [globalAlpha](#) and [globalCompositeOperation](#).

The **`globalAlpha`** attribute gives an alpha value that is applied to shapes and images before they are composited onto the [output bitmap](#). The value must be in the range from 0.0 (fully transparent) to 1.0 (no additional transparency). If an attempt is made to set the attribute to a value outside this range, including Infinity and Not-a-Number (NaN) values, then the attribute must retain its previous value. When the context is created, the [globalAlpha](#) attribute must initially have the value 1.0.

The **`globalCompositeOperation`** attribute sets the *current composition operator*, which controls how shapes and images are drawn onto the [output bitmap](#), once they have had [globalAlpha](#) and the current transformation matrix applied. The possible values are those defined in *Compositing and Blending*, and include the values **`source-over`** and **`copy`**. [\[COMPOSITE\]](#)

These values are all case-sensitive — they must be used exactly as defined. User agents must not recognize values that are not [identical to](#) one of the values given in *Compositing and Blending*. [\[COMPOSITE\]](#)

On setting, if the user agent does not recognize the specified value, it must be ignored, leaving the value of [globalCompositeOperation](#) unaffected. Otherwise, the attribute must be set to the given new value.

When the context is created, the [globalCompositeOperation](#) attribute must initially have the value [source-over](#).

4.12.5.1.17 Image smoothing

`context.imageSmoothingEnabled [= value]`

✓MDN

[CanvasRenderingContext2D/imageSmoothingEnabled](#)

Support in all current engines.

Firefox51+Safari9.1+Chrome30+

Opera17+Edge79+

Edge (Legacy)15+Internet Explorer11

Firefox Android51+Safari iOS9.3+Chrome Android30+WebView Android4.4+Samsung Internet2.0+Opera Android18+

Returns whether pattern fills and the [drawImage\(\)](#) method will attempt to smooth images if their pixels don't line up exactly with the display, when scaling images up.

Can be set, to change whether images are smoothed (true) or not (false).

`context.imageSmoothingQuality [= value]`

MDN

[CanvasRenderingContext2D/imageSmoothingQuality](#)

FirefoxNoSafari9.1+Chrome54+

Opera41+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox AndroidNoSafari iOS9.3+Chrome Android54+WebView Android54+Samsung Internet6.0+Opera Android41+

Returns the current image-smoothing-quality preference.

Can be set, to change the preferred quality of image smoothing. The possible values are

"[low](#)", "[medium](#)" and "[high](#)". Unknown values are ignored.

Objects that implement the [CanvasImageSmoothing](#) interface have attributes that control how image smoothing is performed.

The *imageSmoothingEnabled* attribute, on getting, must return the last value it was set to. On setting, it must be set to the new value. When the object implementing the [CanvasImageSmoothing](#) interface is created, the attribute must be set to true.

The *imageSmoothingQuality* attribute, on getting, must return the last value it was set to. On setting, it must be set to the new value. When the object implementing the [CanvasImageSmoothing](#) interface is created, the attribute must be set to "[low](#)".

4.12.5.1.18 Shadows

All drawing operations on an object which implements the [CanvasShadowStyles](#) interface are affected by the four global shadow attributes.

`context.shadowColor [= value]`

✓MDN

[CanvasRenderingContext2D/shadowColor](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the current shadow color.

Can be set, to change the shadow color. Values that cannot be parsed as CSS colors are ignored.

`context.shadowOffsetX [= value]`

✓MDN

[CanvasRenderingContext2D/shadowOffsetX](#)

Support in all current engines.

Firefox 1.5+ Safari 2+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

context.shadowOffsetY [= value]

✓MDN

[CanvasRenderingContext2D/shadowOffsetY](#)

Support in all current engines.

Firefox1.5+Safari2+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns the current shadow offset.

Can be set, to change the shadow offset. Values that are not finite numbers are ignored.

context.shadowBlur [= value]

✓MDN

[CanvasRenderingContext2D/shadowBlur](#)

Support in all current engines.

Firefox1.5+Safari2+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns the current level of blur applied to shadows.

Can be set, to change the blur level. Values that are not finite numbers greater than or equal to zero are ignored.

The *shadowColor* attribute sets the color of the shadow.

When the context is created, the *shadowColor* attribute initially must be [transparent black](#).

On getting, the [serialization of the color](#) must be returned.

On setting, the new value must be [parsed](#) with this [canvas](#) element and the color assigned. If parsing the value results in failure then it must be ignored, and the attribute must retain its

previous value. [\[CSSCOLOR\]](#)

The `shadowOffsetX` and `shadowOffsetY` attributes specify the distance that the shadow will be offset in the positive horizontal and positive vertical distance respectively. Their values are in coordinate space units. They are not affected by the current transformation matrix.

When the context is created, the shadow offset attributes must initially have the value 0.

On getting, they must return their current value. On setting, the attribute being set must be set to the new value, except if the value is infinite or NaN, in which case the new value must be ignored.

The `shadowBlur` attribute specifies the level of the blurring effect. (The units do not map to coordinate space units, and are not affected by the current transformation matrix.)

When the context is created, the `shadowBlur` attribute must initially have the value 0.

On getting, the attribute must return its current value. On setting the attribute must be set to the new value, except if the value is negative, infinite or NaN, in which case the new value must be ignored.

Shadows are only drawn if the opacity component of the alpha component of the color of `shadowColor` is nonzero and either the `shadowBlur` is nonzero, or the `shadowOffsetX` is nonzero, or the `shadowOffsetY` is nonzero.

When shadows are drawn, they must be rendered as follows:

1. Let A be an infinite [transparent black](#) bitmap on which the source image for which a shadow is being created has been rendered.
2. Let B be an infinite [transparent black](#) bitmap, with a coordinate space and an origin identical to A .
3. Copy the alpha channel of A to B , offset by `shadowOffsetX` in the positive x direction, and `shadowOffsetY` in the positive y direction.
4. If `shadowBlur` is greater than 0:
 1. Let σ be half the value of `shadowBlur`.
 2. Perform a 2D Gaussian Blur on B , using σ as the standard deviation.

User agents may limit values of σ to an implementation-specific maximum value to avoid exceeding hardware limitations during the Gaussian blur operation.

5. Set the red, green, and blue components of every pixel in B to the red, green, and blue components (respectively) of the color of `shadowColor`.

6. Multiply the alpha component of every pixel in B by the alpha component of the color of [`shadowColor`](#).
7. The shadow is in the bitmap B , and is rendered as part of the [drawing model](#) described below.

If the current composition operation is [`copy`](#), then shadows effectively won't render (since the shape will overwrite the shadow).

4.12.5.1.19 Filters

All drawing operations on an object which implements the [`CanvasFilters`](#) interface are affected by the global [`filter`](#) attribute.

`context.filter [= value]`

MDN

[CanvasRenderingContext2D/filter](#)

Firefox49+SafariNoChrome52+

Opera39+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android49+Safari iOSNoChrome Android52+WebView Android52+Samsung Internet6.0+Opera Android41+

Returns the current filter.

Can be set, to change the filter. Values that cannot be parsed as a [`<filter-value-list>`](#) value are ignored.

The [`filter`](#) attribute, on getting, must return the last value it was successfully set to. The value must not be re-serialized. On setting, if the new value is 'none' (not the empty string, null, or undefined), filters must be disabled for the context. Otherwise, the value must be parsed as a [`<filter-value-list>`](#) value. If the value cannot be parsed as a [`<filter-value-list>`](#) value, where using property-independent style sheet syntax like 'inherit' or 'initial' is considered an invalid value, then it must be ignored, and the attribute must retain its previous value. When creating the object implementing the [`CanvasFilters`](#) interface, the attribute must be set to 'none'.

A [`<filter-value-list>`](#) value consists of a sequence of one or more filter functions or references to SVG filters. The input to the filter is used as the input to the first item in the list. Subsequent items take the output of the previous item as their input. [\[FILTERS\]](#)

Coordinates used in the value of the [`filter`](#) attribute are interpreted such that one pixel is equivalent to one SVG user space unit and to one canvas coordinate space unit. Filter coordinates are not affected by the [`current transformation matrix`](#). The current transformation matrix affects only the input to the filter. Filters are applied in the [`output bitmap`](#)'s coordinate

space.

When the value of the [filter](#) attribute defines lengths using percentages or using '[em](#)' or '[ex](#)' units, these must be interpreted relative to the [computed value](#) of the '[font-size](#)' property of the [font style source object](#) at the time that the attribute is set, if it is an element. If the [computed values](#) are undefined for a particular case (e.g. because the [font style source object](#) is not an element or is not [being rendered](#)), then the relative keywords must be interpreted relative to the default value of the [font](#) attribute. The 'larger' and 'smaller' keywords are not supported.

If the value of the [filter](#) attribute refers to an SVG filter in the same document, and this SVG filter changes, then the changed filter is used for the next draw operation.

If the value of the [filter](#) attribute refers to an SVG filter in an external resource document and that document is not loaded when a drawing operation is invoked, then the drawing operation must proceed with no filtering.

4.12.5.1.20 Working with externally-defined SVG filters

This section is non-normative.

Since drawing is performed using filter value 'none' until an externally-defined filter has finished loading, authors might wish to determine whether such a filter has finished loading before proceeding with a drawing operation. One way to accomplish this is to load the externally-defined filter elsewhere within the same page in some element that sends a [load](#) event (for example, an [SVG use](#) element), and wait for the [load](#) event to be dispatched.

4.12.5.1.21 Drawing model

When a shape or image is painted, user agents must follow these steps, in the order given (or act as if they do):

1. Render the shape or image onto an infinite [transparent black](#) bitmap, creating image *A*, as described in the previous sections. For shapes, the current fill, stroke, and line styles must be honored, and the stroke must itself also be subjected to the current transformation matrix.
2. When the filter attribute is set to a value other than 'none' and all the externally-defined filters it references, if any, are in documents that are currently loaded, then use image *A* as the input to the [filter](#), creating image *B*. Otherwise, let *B* be an alias for *A*.
3. [When shadows are drawn](#), render the shadow from image *B*, using the current shadow styles, creating image *C*.
4. [When shadows are drawn](#), multiply the alpha component of every pixel in *C* by [globalAlpha](#).

5. When shadows are drawn, composite C within the [clipping region](#) over the current [output bitmap](#) using the [current composition operator](#).
6. Multiply the alpha component of every pixel in B by [globalAlpha](#).
7. Composite B within the [clipping region](#) over the current [output bitmap](#) using the [current composition operator](#).

When compositing onto the [output bitmap](#), pixels that would fall outside of the [output bitmap](#) must be discarded.

4.12.5.1.22 Best practices

When a canvas is interactive, authors should include [focusable](#) elements in the element's fallback content corresponding to each [focusable](#) part of the canvas, as in the [example above](#).

When rendering focus rings, to ensure that focus rings have the appearance of native focus rings, authors should use the [drawFocusIfNeeded\(\)](#) method, passing it the element for which a ring is being drawn. This method only draws the focus ring if the element is [focused](#), so that it can simply be called whenever drawing the element, without checking whether the element is focused or not first.

In addition to drawing focus rings, authors should use the [scrollPathIntoView\(\)](#) method when an element in the canvas is focused, to make sure it is visible on the screen (if applicable).

Authors should avoid implementing text editing controls using the [canvas](#) element. Doing so has a large number of disadvantages:

- Mouse placement of the caret has to be reimplemented.
- Keyboard movement of the caret has to be reimplemented (possibly across lines, for multiline text input).
- Scrolling of the text control has to be implemented (horizontally for long lines, vertically for multiline input).
- Native features such as copy-and-paste have to be reimplemented.
- Native features such as spell-checking have to be reimplemented.
- Native features such as drag-and-drop have to be reimplemented.
- Native features such as page-wide text search have to be reimplemented.
- Native features specific to the user, for example custom text services, have to be reimplemented. This is close to impossible since each user might have different services installed, and there is an unbounded set of possible such services.
- Bidirectional text editing has to be reimplemented.
- For multiline text editing, line wrapping has to be implemented for all relevant languages.
- Text selection has to be reimplemented.
- Dragging of bidirectional text selections has to be reimplemented.
- Platform-native keyboard shortcuts have to be reimplemented.
- Platform-native input method editors (IMEs) have to be reimplemented.

- Undo and redo functionality has to be reimplemented.
- Accessibility features such as magnification following the caret or selection have to be reimplemented.

This is a huge amount of work, and authors are most strongly encouraged to avoid doing any of it by instead using the [input](#) element, the [textarea](#) element, or the [contenteditable](#) attribute.

4.12.5.1.23 Examples

This section is non-normative.

Here is an example of a script that uses canvas to draw [pretty glowing lines](#).

```
<canvas width="800" height="450"></canvas>
<script>

var context = document.getElementsByTagName('canvas')[0].getContext('2d');

var lastX = context.canvas.width * Math.random();
var lastY = context.canvas.height * Math.random();
var hue = 0;
function line() {
    context.save();
    context.translate(context.canvas.width/2, context.canvas.height/2);
    context.scale(0.9, 0.9);
    context.translate(-context.canvas.width/2, -context.canvas.height/2);
    context.beginPath();
    context.lineWidth = 5 + Math.random() * 10;
    context.moveTo(lastX, lastY);
    lastX = context.canvas.width * Math.random();
    lastY = context.canvas.height * Math.random();
    context.bezierCurveTo(context.canvas.width * Math.random(),
                          context.canvas.height * Math.random(),
                          context.canvas.width * Math.random(),
                          context.canvas.height * Math.random(),
                          lastX, lastY);

    hue = hue + 10 * Math.random();
    context.strokeStyle = 'hsl(' + hue + ', 50%, 50%)';
    context.shadowColor = 'white';
    context.shadowBlur = 10;
    context.stroke();
    context.restore();
}
setInterval(line, 50);
```

```

function blank() {
    context.fillStyle = 'rgba(0,0,0,0.1)';
    context.fillRect(0, 0, context.canvas.width, context.canvas.height);
}
setInterval(blank, 40);

</script>

```

The 2D rendering context for [canvas](#) is often used for sprite-based games. The following example demonstrates this:

[Walk](#) [Stop](#)

Blue Robot Player Sprite by [JohnColburn](#), Licensed under the terms of the Creative Commons Attribution Share-Alike 3.0 Unported license. This work is itself licensed under a [Creative Commons Attribution-ShareAlike 3.0 Unported License](#).

```

<!DOCTYPE HTML>
<html lang="en">
<meta charset="utf-8">
<title>Blue Robot Demo</title>
<style>
    html { overflow: hidden; min-height: 200px; min-width: 380px; }
    body { height: 200px; position: relative; margin: 8px; }
    .buttons { position: absolute; bottom: 0px; left: 0px; margin: 4px; }
</style>
<canvas width="380" height="200"></canvas>
<script>
    var Landscape = function (context, width, height) {
        this.offset = 0;
        this.width = width;
        this.advance = function (dx) {
            this.offset += dx;
        };
        this.horizon = height * 0.7;
        // This creates the sky gradient (from a darker blue to white at the bottom)
        this.sky = context.createLinearGradient(0, 0, 0, this.horizon);
        this.sky.addColorStop(0.0, 'rgb(55,121,179)');
        this.sky.addColorStop(0.7, 'rgb(121,194,245)');
    };
    var robot = new Image();
    robot.src = 'blue-robot.png';
    robot.onload = function () {
        var landscape = new Landscape(context, 380, 200);
        var player = document.querySelector('.player');
        var walk = document.querySelector('.walk');
        var stop = document.querySelector('.stop');

        walk.addEventListener('click', function () {
            landscape.advance(10);
            player.style.left = landscape.offset + 'px';
        });
        stop.addEventListener('click', function () {
            landscape.advance(-10);
            player.style.left = landscape.offset + 'px';
        });

        context.drawImage(robot, 0, 0, 380, 200);
    };
</script>

```

```
this.sky.addColorStop(1.0, 'rgb(164,200,214)');
// this creates the grass gradient (from a darker green to a lighter green
this.earth = context.createLinearGradient(0, this.horizon, 0, height);
this.earth.addColorStop(0.0, 'rgb(81,140,20)');
this.earth.addColorStop(1.0, 'rgb(123,177,57)');
this.paintBackground = function (context, width, height) {
    // first, paint the sky and grass rectangles
    context.fillStyle = this.sky;
    context.fillRect(0, 0, width, this.horizon);
    context.fillStyle = this.earth;
    context.fillRect(0, this.horizon, width, height-this.horizon);
    // then, draw the cloudy banner
    // we make it cloudy by having the draw text off the top of the
    // canvas, and just having the blurred shadow shown on the canvas
    context.save();
    context.translate(width-((this.offset+(this.width*3.2)) % (this.width*4.0)));
    context.shadowColor = 'white';
    context.shadowOffsetY = 30+this.horizon/3; // offset down on canvas
    context.shadowBlur = '5';
    context.fillStyle = 'white';
    context.textAlign = 'left';
    context.textBaseline = 'top';
    context.font = '20px sans-serif';
    context.fillText('WHATWG ROCKS', 10, -30); // text up above canvas
    context.restore();
    // then, draw the background tree
    context.save();
    context.translate(width-((this.offset+(this.width*0.2)) % (this.width*1.5)));
    context.beginPath();
    context.fillStyle = 'rgb(143,89,2)';
    context.strokeStyle = 'rgb(10,10,10)';
    context.lineWidth = 2;
    context.rect(0, this.horizon+5, 10, -50); // trunk
    context.fill();
    context.stroke();
    context.beginPath();
    context.fillStyle = 'rgb(78,154,6)';
    context.arc(5, this.horizon-60, 30, 0, Math.PI*2); // leaves
    context.fill();
    context.stroke();
    context.restore();
};
this.paintForeground = function (context, width, height) {
    // draw the box that goes in front
    context.save();
    context.translate(width-((this.offset+(this.width*0.7)) % (this.width*1.5)));
    context.beginPath();
```

```
        context.rect(0, this.horizon - 5, 25, 25);
        context.fillStyle = 'rgb(220,154,94)';
        context.strokeStyle = 'rgb(10,10,10)';
        context.lineWidth = 2;
        context.fill();
        context.stroke();
        context.restore();
    };
};

</script>
<script>
var BlueRobot = function () {
    this.sprites = new Image();
    this.sprites.src = 'blue-robot.png'; // this sprite sheet has 8 cells
    this.targetMode = 'idle';
    this.walk = function () {
        this.targetMode = 'walk';
    };
    this.stop = function () {
        this.targetMode = 'idle';
    };
    this.frameIndex = {
        'idle': [0], // first cell is the idle frame
        'walk': [1,2,3,4,5,6], // the walking animation is cells 1-6
        'stop': [7], // last cell is the stopping animation
    };
    this.mode = 'idle';
    this.frame = 0; // index into frameIndex
    this.tick = function () {
        // this advances the frame and the robot
        // the return value is how many pixels the robot has moved
        this.frame += 1;
        if (this.frame >= this.frameIndex[this.mode].length) {
            // we've reached the end of this animation cycle
            this.frame = 0;
            if (this.mode != this.targetMode) {
                // switch to next cycle
                if (this.mode == 'walk') {
                    // we need to stop walking before we decide what to do next
                    this.mode = 'stop';
                } else if (this.mode == 'stop') {
                    if (this.targetMode == 'walk')
                        this.mode = 'walk';
                    else
                        this.mode = 'idle';
                } else if (this.mode == 'idle') {
                    if (this.targetMode == 'walk')

```

```

        this.mode = 'walk';
    }
}
if (this.mode == 'walk')
    return 8;
return 0;
},
this.paint = function (context, x, y) {
    if (!this.sprites.complete) return;
    // draw the right frame out of the sprite sheet onto the canvas
    // we assume each frame is as high as the sprite sheet
    // the x,y coordinates give the position of the bottom center of the spr
    context.drawImage(this.sprites,
                      this.frameIndex[this.mode][this.frame] * this.sprites.l
                      x-this.sprites.height/2, y-this.sprites.height, this.sp
    );
};

</script>
<script>
var canvas = document.getElementsByTagName('canvas')[0];
var context = canvas.getContext('2d');
var landscape = new Landscape(context, canvas.width, canvas.height);
var blueRobot = new BlueRobot();
// paint when the browser wants us to, using requestAnimationFrame()
function paint() {
    context.clearRect(0, 0, canvas.width, canvas.height);
    landscape.paintBackground(context, canvas.width, canvas.height);
    blueRobot.paint(context, canvas.width/2, landscape.horizon*1.1);
    landscape.paintForeground(context, canvas.width, canvas.height);
    requestAnimationFrame(paint);
}
paint();
// but tick every 100ms, so that we don't slow down when we don't paint
setInterval(function () {
    var dx = blueRobot.tick();
    landscape.advance(dx);
}, 100);
</script>
<p class="buttons">
    <input type=button value="Walk" onclick="blueRobot.walk()">
    <input type=button value="Stop" onclick="blueRobot.stop()">
<footer>
    <small> Blue Robot Player Sprite by <a href="https://johncolburn.deviantart.com/art/Blue-Robot-Player-Sprite-134301105">John Colburn</a>
    Licensed under the terms of the Creative Commons Attribution Share-Alike 3.0 Unported License
    <small> This work is itself licensed under a <a rel="license" href="https://creativecommons.org/licenses/by-sa/3.0/unported">Creative Commons Attribution-ShareAlike 3.0 Unported License</a>.</small>

```

```
</footer>
```

4.12.5.2 The [ImageBitmap](#) rendering context

4.12.5.2.1 Introduction

[ImageBitmapRenderingContext](#) is a performance-oriented interface that provides a low overhead method for displaying the contents of [ImageBitmap](#) objects. It uses transfer semantics to reduce overall memory consumption. It also streamlines performance by avoiding intermediate compositing, unlike the [drawImage\(\)](#) method of [CanvasRenderingContext2D](#).

Using an [img](#) element as an intermediate for getting an image resource into a canvas, for example, would result in two copies of the decoded image existing in memory at the same time: the [img](#) element's copy, and the one in the canvas's backing store. This memory cost can be prohibitive when dealing with extremely large images. This can be avoided by using [ImageBitmapRenderingContext](#).

Using [ImageBitmapRenderingContext](#), here is how to transcode an image to the JPEG format in a memory- and CPU-efficient way:

```
createImageBitmap(inputImageBlob).then(image => {
  const canvas = document.createElement('canvas');
  const context = canvas.getContext('bitmaprenderer');
  context.transferFromImageBitmap(image);

  canvas.toBlob(outputJPEGBlob => {
    // Do something with outputJPEGBlob.
  }, 'image/jpeg');
});
```

4.12.5.2.2 The [ImageBitmapRenderingContext](#) interface



[ImageBitmapRenderingContext](#)

Support in all current engines.

Firefox 46+ Safari 15+ Chrome 56+

Opera 43+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 46+ Safari iOS 15+ Chrome Android 56+ WebView Android 56+ Samsung Internet 6.0+ Opera Android 43+

```
[Exposed=(Window,Worker)]
interface ImageBitmapRenderingContext {
  readonly attribute (HTMLCanvasElement or OffscreenCanvas) canvas;
  undefined transferFromImageBitmap(ImageBitmap? bitmap);
};

dictionary ImageBitmapRenderingContextSettings {
  boolean alpha = true;
};

context = canvas.getContext('bitmaprenderer' [, { [ alpha: false ] } ])
```

Returns an [ImageBitmapRenderingContext](#) object that is permanently bound to a particular [canvas](#) element.

If the [alpha](#) setting is provided and set to false, then the canvas is forced to always be opaque.

[context.canvas](#)

Returns the [canvas](#) element that the context is bound to.

[context.transferFromImageBitmap\(imageBitmap\)](#)

✓MDN

[ImageBitmapRenderingContext/transferFromImageBitmap](#)

Support in all current engines.

Firefox 52+ Safari 15+ Chrome 56+

Opera 43+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 52+ Safari iOS 15+ Chrome Android 56+ WebView Android 56+ Samsung Internet 6.0+ Opera Android 43+

Transfers the underlying [bitmap data](#) from *imageBitmap* to *context*, and the bitmap becomes the contents of the [canvas](#) element to which *context* is bound.

[context.transferFromImageBitmap\(null\)](#)

Replaces contents of the [canvas](#) element to which *context* is bound with a [transparent black](#) bitmap whose size corresponds to the [width](#) and [height](#) content attributes of the [canvas](#) element.

The [canvas](#) attribute must return the value it was initialized to when the object was created.

An [ImageBitmapRenderingContext](#) object has an *output bitmap*, which is a reference to [bitmap data](#).

An [ImageBitmapRenderingContext](#) object has a *bitmap mode*, which can be set to [valid](#) or [blank](#). A value of [valid](#) indicates that the context's [output bitmap](#) refers to [bitmap data](#) that was acquired via [transferFromImageBitmap\(\)](#). A value [blank](#) indicates that the context's [output bitmap](#) is a default transparent bitmap.

An [ImageBitmapRenderingContext](#) object also has an *alpha* flag, which can be set to true or false. When an [ImageBitmapRenderingContext](#) object has its [alpha](#) flag set to false, the contents of the [canvas](#) element to which the context is bound are obtained by compositing the context's [output bitmap](#) onto an [opaque black](#) bitmap of the same size using the source-over composite operation. If the [alpha](#) flag is set to true, then the [output bitmap](#) is used as the contents of the [canvas](#) element to which the context is bound. [\[COMPOSITE\]](#)

The step of compositing over an [opaque black](#) bitmap ought to be elided whenever equivalent results can be obtained more efficiently by other means.

When a user agent is required to set an *ImageBitmapRenderingContext*'s *output bitmap*, with a *context* argument that is an [ImageBitmapRenderingContext](#) object and an optional argument *bitmap* that refers to [bitmap data](#), it must run these steps:

1. If a *bitmap* argument was not provided, then:
 1. Set *context*'s [bitmap mode](#) to [blank](#).
 2. Let *canvas* be the [canvas](#) element to which *context* is bound.
 3. Set *context*'s [output bitmap](#) to be [transparent black](#) with an [intrinsic width](#) equal to [the numeric value](#) of *canvas*'s [width](#) attribute and an [intrinsic height](#) equal to [the numeric value](#) of *canvas*'s [height](#) attribute, those values being interpreted in [CSS pixels](#).
 4. Set the [output bitmap](#)'s [origin-clean](#) flag to true.
2. If a *bitmap* argument was provided, then:
 1. Set *context*'s [bitmap mode](#) to [valid](#).
 2. Set *context*'s [output bitmap](#) to refer to the same underlying bitmap data as *bitmap*, without making a copy.

The [origin-clean](#) flag of *bitmap* is included in the bitmap data to be referenced by *context*'s [output bitmap](#).

The *ImageBitmapRenderingContext* creation algorithm, which is passed a *target* and *options*, consists of running these steps:

1. Let *settings* be the result of [converting *options* to the dictionary type *ImageBitmapRenderingContextSettings*](#). (This can throw an exception.)
2. Let *context* be a new [*ImageBitmapRenderingContext*](#) object.
3. Initialize *context*'s [*canvas*](#) attribute to point to *target*.
4. Set *context*'s [*output bitmap*](#) to the same bitmap as *target*'s bitmap (so that they are shared).
5. Run the steps to [set an *ImageBitmapRenderingContext*'s output bitmap](#) with *context*.
6. Initialize *context*'s [*alpha*](#) flag to true.
7. Process each of the members of *settings* as follows:

alpha

If false, then set *context*'s [*alpha*](#) flag to false.

8. Return *context*.

The *transferFromImageBitmap(bitmap)* method, when invoked, must run these steps:

1. Let *bitmapContext* be the [*ImageBitmapRenderingContext*](#) object on which the [*transferFromImageBitmap\(\)*](#) method was called.
2. If *bitmap* is null, then run the steps to [set an *ImageBitmapRenderingContext*'s output bitmap](#), with *bitmapContext* as the *context* argument and no *bitmap* argument, then return.
3. If the value of *bitmap*'s [*\[\[Detached\]\]*](#) internal slot is set to true, then throw an [*"InvalidStateError"* *DOMException*](#).
4. Run the steps to [set an *ImageBitmapRenderingContext*'s output bitmap](#), with the *context* argument equal to *bitmapContext*, and the *bitmap* argument referring to *bitmap*'s underlying [*bitmap data*](#).
5. Set the value of *bitmap*'s [*\[\[Detached\]\]*](#) internal slot to true.
6. Unset *bitmap*'s [*bitmap data*](#).

4.12.5.3 The [OffscreenCanvas](#) interface

MDN

[OffscreenCanvas](#)

Support in one engine only.

Firefox 44+ Safari No Chrome 69+

Opera 56+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 44+ Safari iOS No Chrome Android 69+ WebView Android No Samsung Internet 10.0+ Opera Android 48+

```
typedef (OffscreenCanvasRenderingContext2D or ImageBitmapRenderingContext or WebGLRenderingContext) OffscreenRenderingContext;
```

```
dictionary ImageEncodeOptions {
  DOMString type = "image/png";
  unrestricted double quality;
};

enum OffscreenRenderingContextId { "2d", "bitmapreenderer", "webgl", "webgl2" };

[Exposed=(Window,Worker), Transferable]
interface OffscreenCanvas : EventTarget {
  constructor([EnforceRange] unsigned long long width, [EnforceRange] unsigned long long height);

  attribute [EnforceRange] unsigned long long width;
  attribute [EnforceRange] unsigned long long height;

  OffscreenRenderingContext? getContext(OffscreenRenderingContextId contextId);
  ImageBitmap transferToImageBitmap();
  Promise<Blob> convertToBlob(optional ImageEncodeOptions options = {});

  attribute EventHandler oncontextlost;
  attribute EventHandler oncontextrestored;
};
```

[OffscreenCanvas](#) is an [EventTarget](#), so both [OffscreenCanvasRenderingContext2D](#) and WebGL can fire events at it. [OffscreenCanvasRenderingContext2D](#) can fire [contextlost](#) and [contextrestored](#), and WebGL can fire [webglcontextlost](#) and [webglcontextrestored](#). [\[WEBGL\]](#)

[OffscreenCanvas](#) objects are used to create rendering contexts, much like an [HTMLCanvasElement](#), but with no connection to the DOM. This makes it possible to use canvas rendering contexts in [workers](#).

ΔMDN

[WebGLRenderingContext/commit](#)

Support in one engine only.

Firefox 44+ Safari No Chrome No

Opera No Edge No

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android No WebView Android No Samsung Internet No Opera Android No

An [OffscreenCanvas](#) object may hold a weak reference to a *placeholder canvas* element, which is typically in the DOM, whose embedded content is provided by the [OffscreenCanvas](#) object. The bitmap of the [OffscreenCanvas](#) object is pushed to the [placeholder canvas element](#) by calling the `commit()` method of the [OffscreenCanvas](#) object's rendering context. All rendering context types that can be created by an [OffscreenCanvas](#) object must implement a `commit()` method. The exact behavior of the commit method (e.g. whether it copies or transfers bitmaps) may vary, as defined by the rendering contexts' respective specifications. Only the [2D context for offscreen canvases](#) is defined in this specification.

`offscreenCanvas = new OffscreenCanvas(width, height)`

ΔMDN

[OffscreenCanvas/OffscreenCanvas](#)

Support in one engine only.

Firefox 46+ Safari No Chrome 69+

Opera 56+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 46+ Safari iOS No Chrome Android 69+ WebView Android No Samsung Internet 10.0+ Opera Android Yes

Returns a new [OffscreenCanvas](#) object that is not linked to a [placeholder canvas element](#), and whose bitmap's size is determined by the `width` and `height` arguments.

`context = offscreenCanvas.getContext(contextId [, options])`

ΔMDN

[OffscreenCanvas/getContext](#)

Support in one engine only.

Firefox 44+ Safari No Chrome 69+

Opera56+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android44+Safari iOSNoChrome Android69+WebView AndroidNoSamsung Internet10.0+Opera Android48+

Returns an object that exposes an API for drawing on the [OffscreenCanvas](#) object. *contextId* specifies the desired API: "[2d](#)", "[bitmaprenderer](#)", "[webgl](#)", "[webgl2](#)", or "[webgpu](#)". *options* is handled by that API.

This specification defines the "[2d](#)" context below, which is similar but distinct from the "[2d](#)" context that is created from a [canvas](#) element. The WebGL specifications define the "[webgl](#)" and "[webgl2](#)" contexts. WebGPU defines the "[webgpu](#)" context. [WEBGL] [WEBGPU]

Returns null if the canvas has already been initialized with another context type (e.g., trying to get a "[2d](#)" context after getting a "[webgl](#)" context).

An [OffscreenCanvas](#) object has an internal *bitmap* that is initialized when the object is created. The width and height of the [bitmap](#) are equal to the values of the [width](#) and [height](#) attributes of the [OffscreenCanvas](#) object. Initially, all the bitmap's pixels are [transparent black](#).

An [OffscreenCanvas](#) object can have a rendering context bound to it. Initially, it does not have a bound rendering context. To keep track of whether it has a rendering context or not, and what kind of rendering context it is, an [OffscreenCanvas](#) object also has a *context mode*, which is initially *none* but can be changed to either *2d*, *bitmaprenderer*, *webgl*, *webgl2*, *webgpu*, or *detached* by algorithms defined in this specification.

The constructor *OffscreenCanvas(width, height)*, when invoked, must create a new [OffscreenCanvas](#) object with its [bitmap](#) initialized to a rectangular array of [transparent black](#) pixels of the dimensions specified by *width* and *height*; and its [width](#) and [height](#) attributes initialized to *width* and *height* respectively.

[OffscreenCanvas](#) objects are [transferable](#). Their [transfer steps](#), given *value* and *dataHolder*, are as follows:

1. If *value*'s [context mode](#) is not equal to [none](#), then throw an "[InvalidStateError](#)" [DOMException](#).
2. Set *value*'s [context mode](#) to [detached](#).
3. Let *width* and *height* be the dimensions of *value*'s [bitmap](#).
4. Unset *value*'s [bitmap](#).
5. Set *dataHolder*.[[Width]] to *width* and *dataHolder*.[[Height]] to *height*.

- Set `dataHolder.[[PlaceholderCanvas]]` to be a weak reference to `value`'s [placeholder canvas element](#), if `value` has one, or null if it does not.

Their [transfer-receiving steps](#), given `dataHolder` and `value`, are:

- Initialize `value`'s [bitmap](#) to a rectangular array of [transparent black](#) pixels with width given by `dataHolder.[[Width]]` and height given by `dataHolder.[[Height]]`.
 - If `dataHolder.[[PlaceholderCanvas]]` is not null, set `value`'s [placeholder canvas element](#) to `dataHolder.[[PlaceholderCanvas]]` (while maintaining the weak reference semantics).
-

The `getContext(contextId, options)` method of an [OffscreenCanvas](#) object, when invoked, must run these steps:

- If `options` is not an [object](#), then set `options` to null.
- Set `options` to the result of [converting](#) `options` to a JavaScript value.
- Run the steps in the cell of the following table whose column header matches this [OffscreenCanvas](#) object's [context mode](#) and whose row header matches `contextId`:

	none	2d	bitmaprenderer	webgpu
"2d"	Follow the offscreen 2D context creation algorithm defined in the section below, passing it this OffscreenCanvas object and <code>options</code> , to obtain an OffscreenCanvasRenderingContext2D object; if this does not throw an exception, then set this OffscreenCanvas object's context mode to 2d , and return the new OffscreenCanvasRenderingContext2D object.	Return the same object as was returned the last time the method was invoked with this same first argument.	Return null.	Return null.
"bitmaprenderer"	Follow the ImageBitmapRenderingContext creation algorithm defined in the section above, passing it this OffscreenCanvas object and <code>options</code> , to obtain an ImageBitmapRenderingContext object; if this does not throw an exception, then set this OffscreenCanvas object's context mode to bitmaprenderer , and return the new ImageBitmapRenderingContext object.	Return the same object as was returned the last time the method was invoked with this same first argument.	Return null.	Return null.

	none	2d	bitmaprenderer	web
" webgl " or " webgl2 "	Follow the instructions given in the WebGL specifications' <i>Context Creation</i> sections to obtain either a WebGLRenderingContext , WebGL2RenderingContext , or null; if the returned value is null, then return null; otherwise, set this OffscreenCanvas object's context mode to webgl or webgl2 , and return the WebGLRenderingContext or WebGL2RenderingContext object. [WEBGL]	Return null.	Return null.	Return null. the s value was return the la time meth was invol with same argu
" webgpu "	Follow the instructions given in <i>WebGPU's Canvas Rendering</i> section to obtain a GPUCanvasContext or null; if the returned value is null, then return null; otherwise, set this OffscreenCanvas object's context mode to webgpu and return the GPUCanvasContext object. [WEBGPU]	Return null.	Return null.	Retu null.

`offscreenCanvas.width [= value]`

ΔMDN

[OffscreenCanvas/width](#)

Support in one engine only.

Firefox 44+ Safari No Chrome 69+

Opera 56+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 44+ Safari iOS No Chrome Android 69+ WebView Android No Samsung Internet 10.0+ Opera Android 48+

`offscreenCanvas.height [= value]`

ΔMDN

[OffscreenCanvas/height](#)

Support in one engine only.

Firefox 44+ Safari No Chrome 69+

Opera 56+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 44+ Safari iOS No Chrome Android 69+ WebView Android No Samsung

Internet 10.0+ Opera Android 48+

These attributes return the dimensions of the [OffscreenCanvas](#) object's [bitmap](#).

They can be set, to replace the [bitmap](#) with a new, [transparent black](#) bitmap of the specified dimensions (effectively resizing it).

If either the [*width*](#) or [*height*](#) attributes of an [OffscreenCanvas](#) object are set (to a new value or to the same value as before) and the [OffscreenCanvas](#) object's [context mode](#) is [2d](#), then [reset the rendering context to its default state](#) and resize the [OffscreenCanvas](#) object's [bitmap](#) to the new values of the [*width*](#) and [*height*](#) attributes.

The resizing behavior for "[webgl](#)" and "[webgl2](#)" contexts is defined in the WebGL specifications. [\[WEBGL\]](#)

The resizing behavior for "[webgpu](#)" context is defined in WebGPU. [\[WEBGPU\]](#)

If an [OffscreenCanvas](#) object whose dimensions were changed has a [placeholder canvas element](#), then the [placeholder canvas element](#)'s [intrinsic size](#) will only be updated via the [commit\(\)](#) method of the [OffscreenCanvas](#) object's rendering context.

`promise = offscreenCanvas.convertToBlob([options])`

[MDN](#)

[OffscreenCanvas/convertToBlob](#)

Support in one engine only.

Firefox 46+ Safari No Chrome 69+

Opera 56+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 46+ Safari iOS No Chrome Android 69+ WebView Android No Samsung

Internet 10.0+ Opera Android 48+

Returns a promise that will fulfill with a new [Blob](#) object representing a file containing the image in the [OffscreenCanvas](#) object.

The argument, if provided, is a dictionary that controls the encoding options of the image file to be created. The [*type*](#) field specifies the file format and has a default value of "[image/png](#)"; that type is also used if the requested type isn't supported. If the image

format supports variable quality (such as "[image/jpeg](#)"), then the `quality` field is a number in the range 0.0 to 1.0 inclusive indicating the desired quality level for the resulting image.

`canvas.transferToImageBitmap()`

MDN

[OffscreenCanvas/transferToImageBitmap](#)

Support in one engine only.

Firefox  46+ Safari No Chrome 69+

Opera 56+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android  46+ Safari iOS No Chrome Android 69+ WebView Android No Samsung Internet 10.0+ Opera Android 48+

Returns a newly created [ImageBitmap](#) object with the image in the [OffscreenCanvas](#) object. The image in the [OffscreenCanvas](#) object is replaced with a new blank image.

The `convertToBlob(options)` method, when invoked, must run the following steps:

1. If the value of this [OffscreenCanvas](#) object's `[[Detached]]` internal slot is set to true, then return a promise rejected with an "[InvalidStateError](#)" [DOMException](#).
2. If this [OffscreenCanvas](#) object's `context mode` is `2d` and the rendering context's `bitmap`'s `origin-clean` flag is set to false, then return a promise rejected with a "[SecurityError](#)" [DOMException](#).
3. If this [OffscreenCanvas](#) object's `bitmap` has no pixels (i.e., either its horizontal dimension or its vertical dimension is zero) then return a promise rejected with an "[IndexSizeError](#)" [DOMException](#).
4. Let `bitmap` be a copy of this [OffscreenCanvas](#) object's `bitmap`.
5. Let `result` be a new promise object.
6. Run these steps [in parallel](#):
 1. Let `file` be [a serialization of `bitmap` as a `file`](#), with `options`'s `type` and `quality` if present.
 2. [Queue an element task](#) on the [canvas blob serialization task source](#) given the [canvas](#) element to run these steps:
 1. If `file` is null, then reject `result` with an "[EncodingException](#)"

[DOMException](#).

2. Otherwise, resolve *result* with a new [Blob](#) object, created in the [relevant Realm](#) of this [OffscreenCanvas](#) object, representing *file*. [\[FILEAPI\]](#)
7. Return *result*.

The [transferToImageBitmap\(\)](#) method, when invoked, must run the following steps:

1. If the value of this [OffscreenCanvas](#) object's [\[\[Detached\]\]](#) internal slot is set to true, then throw an "[InvalidStateError](#)" [DOMException](#).
2. If this [OffscreenCanvas](#) object's [context mode](#) is set to [none](#), then throw an "[InvalidStateError](#)" [DOMException](#).
3. Let *image* be a newly created [ImageBitmap](#) object that references the same underlying bitmap data as this [OffscreenCanvas](#) object's [bitmap](#).
4. Set this [OffscreenCanvas](#) object's [bitmap](#) to reference a newly created bitmap of the same dimensions and color space as the previous bitmap, and with its pixels initialized to [transparent black](#), or [opaque black](#) if the rendering context's [alpha](#) flag is set to false.

This means that if the rendering context of this [OffscreenCanvas](#) is a [WebGLRenderingContext](#), the value of [preserveDrawingBuffer](#) will have no effect. [\[WEBGL\]](#)

5. Return *image*.

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the [OffscreenCanvas](#) interface:

Event handler	Event handler event type
oncontextlost	contextlost
oncontextrestored	contextrestored

4.12.5.3.1 The offscreen 2D rendering context

```
[Exposed=(Window,Worker)]
interface OffscreenCanvasRenderingContext2D {
  undefined commit();
  readonly attribute OffscreenCanvas canvas;
};

OffscreenCanvasRenderingContext2D includes CanvasState;
OffscreenCanvasRenderingContext2D includes CanvasTransform;
```

[OffscreenCanvasRenderingContext2D](#) includes [CanvasCompositing](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasImageSmoothing](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasFillStrokeStyles](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasShadowStyles](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasFilters](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasRect](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasDrawPath](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasText](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasDrawImage](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasImageData](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasPathDrawingStyles](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasTextDrawingStyles](#);
[OffscreenCanvasRenderingContext2D](#) includes [CanvasPath](#);

The [OffscreenCanvasRenderingContext2D](#) object is a rendering context for drawing to the [bitmap](#) of an [OffscreenCanvas](#) object. It is similar to the [CanvasRenderingContext2D](#) object, with the following differences:

- there is no support for [user interface](#) features;
- its [canvas](#) attribute refers to an [OffscreenCanvas](#) object rather than a [canvas](#) element;
- it has a [commit\(\)](#) method for pushing the rendered image to the context's [OffscreenCanvas](#) object's [placeholder canvas](#) element.

An [OffscreenCanvasRenderingContext2D](#) object has a *bitmap* that is initialized when the object is created.

The [bitmap](#) has an *origin-clean* flag, which can be set to true or false. Initially, when one of these bitmaps is created, its [origin-clean](#) flag must be set to true.

An [OffscreenCanvasRenderingContext2D](#) object also has an *alpha* flag, which can be set to true or false. Initially, when the context is created, its alpha flag must be set to true. When an [OffscreenCanvasRenderingContext2D](#) object has its [alpha](#) flag set to false, then its alpha channel must be fixed to 1.0 (fully opaque) for all pixels, and attempts to change the alpha component of any pixel must be silently ignored.

An [OffscreenCanvasRenderingContext2D](#) object also has a *color space* setting of type [PredefinedColorSpace](#). The color space for the context's [bitmap](#) is set to the context's [color space](#).

An [OffscreenCanvasRenderingContext2D](#) object has an associated *OffscreenCanvas* object, which is the [OffscreenCanvas](#) object from which the [OffscreenCanvasRenderingContext2D](#) object was created.

`offscreenCanvasRenderingContext2D.commit()`

Copies the rendering context's [bitmap](#) to the bitmap of the [placeholder canvas element](#) of the [associated OffscreenCanvas object](#). The copy operation is synchronous. Calling this method is not needed for the transfer, since it happens automatically during the [event loop](#) execution.

`offscreenCanvas = offscreenCanvasRenderingContext2D.canvas`

Returns the [associated OffscreenCanvas object](#).

The *offscreen 2D context creation algorithm*, which is passed a *target* (an [OffscreenCanvas object](#)) and optionally some arguments, consists of running the following steps:

1. If the algorithm was passed some arguments, let *arg* be the first such argument. Otherwise, let *arg* be undefined.
2. Let *settings* be the result of [converting arg to the dictionary type CanvasRenderingContext2DSettings](#). (This can throw an exception.).
3. Let *context* be a new [OffscreenCanvasRenderingContext2D](#) object.
4. Set *context*'s [associated OffscreenCanvas object](#) to *target*.
5. If *settings*[["alpha"](#)] is false, then set *context*'s [alpha](#) flag to false.
6. Set *context*'s [color space](#) to *settings*[["colorSpace"](#)].
7. Set *context*'s [bitmap](#) to a newly created bitmap with the dimensions specified by the [width](#) and [height](#) attributes of *target*, and set *target*'s bitmap to the same bitmap (so that they are shared).
8. If *context*'s [alpha](#) flag is set to true, initialize all the pixels of *context*'s [bitmap](#) to [transparent black](#). Otherwise, initialize the pixels to [opaque black](#).
9. Return *context*.

The `commit()` method, when invoked, must run the following steps:

1. If this [OffscreenCanvasRenderingContext2D](#)'s [associated OffscreenCanvas object](#) does not have a [placeholder canvas element](#), then return.
2. Let *image* be a copy of this [OffscreenCanvasRenderingContext2D](#)'s [bitmap](#), including the value of its [origin-clean](#) flag.
3. [Queue an element task](#) on the [DOM manipulation task source](#) given the [placeholder canvas element](#) to set the [placeholder canvas element](#)'s [output bitmap](#) to be a

reference to *image*.

If *image* has different dimensions than the bitmap previously referenced as the [placeholder canvas element's output bitmap](#), then this task will result in a change in the [placeholder canvas element's intrinsic size](#), which can affect document layout.

Implementations are encouraged to short-circuit the graphics update steps of the [window event loop](#) for the purposes of updating the contents of a [placeholder canvas element](#) to the display. This could mean, for example, that the [commit\(\)](#) method can copy the bitmap contents directly to a graphics buffer that is mapped to the physical display location of the [placeholder canvas element](#). This or similar short-circuiting approaches can significantly reduce display latency, especially in cases where the [commit\(\)](#) method is invoked from a [worker event loop](#) and the [window event loop](#) of the [placeholder canvas element](#) is busy. However, such shortcuts cannot have any script-observable side-effects. This means that the committed bitmap still needs to be sent to the [placeholder canvas element](#), in case the element is used as a [CanvasImageSource](#), as an [ImageBitmapSource](#), or in case [toDataURL\(\)](#) or [toBlob\(\)](#) are called on it.

The *canvas* attribute, on getting, must return this [OffscreenCanvasRenderingContext2D's associated OffscreenCanvas object](#).

4.12.5.4 Color spaces and color space conversion

The [canvas](#) APIs provide mechanisms for specifying the color space of the canvas's backing store. The default backing store color space for all canvas APIs is '[srgb](#)'.

Color space conversion must be applied to the canvas's backing store when rendering the canvas to the output device. This color space conversion must be identical to the color space conversion that would be applied to an [img](#) element with a color profile that specifies the same [color space](#) as the canvas's backing store.

When drawing content to a 2D context, all inputs must be converted to the [context's color space](#) before drawing. Interpolation of gradient color stops must be performed on color values after conversion to the [context's color space](#). Alpha blending must be performed on values after conversion to the [context's color space](#).

There do not exist any inputs to a 2D context for which the color space is undefined. The color space for CSS colors is defined in *CSS Color*. The color space for images that specify no color profile information is assumed to be '[srgb](#)', as specified in the [Color Spaces of Untagged Colors](#) section of *CSS Color*. [\[CSSCOLOR\]](#)

4.12.5.5 Serializing bitmaps to a file

When a user agent is to create a *serialization of the bitmap as a file*, given a *type* and an optional *quality*, it must create an image file in the format given by *type*. If an error occurs during the creation of the image file (e.g. an internal encoder error), then the result of the serialization is null. [\[PNG\]](#)

The image file's pixel data must be the bitmap's pixel data scaled to one image pixel per coordinate space unit, and if the file format used supports encoding resolution metadata, the resolution must be given as 96dpi (one image pixel per [CSS pixel](#)).

If *type* is supplied, then it must be interpreted as a [MIME type](#) giving the format to use. If the type has any parameters, then it must be treated as not supported.

For example, the value "[image/png](#)" would mean to generate a PNG image, the value "[image/jpeg](#)" would mean to generate a JPEG image, and the value "[image/svg+xml](#)" would mean to generate an SVG image (which would require that the user agent track how the bitmap was generated, an unlikely, though potentially awesome, feature).

User agents must support PNG ("[image/png](#)"). User agents may support other types. If the user agent does not support the requested type, then it must create the file using the PNG format. [\[PNG\]](#)

User agents must [convert the provided type to ASCII lowercase](#) before establishing if they support that type.

For image types that do not support an alpha channel, the serialized image must be the bitmap image composited onto an [opaque black](#) background using the source-over operator.

For image types that support color profiles, the serialized image must include a color profile indicating the color space of the underlying bitmap. For image types that do not support color profiles, the serialized image must be converted to the '[srgb](#)' color space using '[relative-colorimetric](#)' rendering intent.

Thus, in the 2D context, calling the [drawImage\(\)](#) method to render the output of the [toDataURL\(\)](#) or [toBlob\(\)](#) method to the canvas, given the appropriate dimensions, has no visible effect beyond, at most, clipping colors of the canvas to a more narrow gamut.

If *type* is an image format that supports variable quality (such as "[image/jpeg](#)"), *quality* is given, and *type* is not "[image/png](#)", then, if [Type\(quality\)](#) is Number, and *quality* is in the range 0.0 to 1.0 inclusive, the user agent must treat *quality* as the desired quality level. Otherwise, the user agent must use its default quality value, as if the *quality* argument had not been given.

The use of type-testing here, instead of simply declaring *quality* as a Web IDL **double**, is a historical artifact.

Different implementations can have slightly different interpretations of "quality". When the quality is not specified, an implementation-specific default is used that represents a reasonable compromise between compression ratio, image quality, and encoding time.

4.12.5.6 Security with [canvas](#) elements

This section is non-normative.

Information leakage can occur if scripts from one [origin](#) can access information (e.g. read pixels) from images from another origin (one that isn't the [same](#)).

To mitigate this, bitmaps used with [canvas](#) elements and [ImageBitmap](#) objects are defined to have a flag indicating whether they are [origin-clean](#). All bitmaps start with their [origin-clean](#) set to true. The flag is set to false when cross-origin images are used.

The [toDataURL\(\)](#), [toBlob\(\)](#), and [getImageData\(\)](#) methods check the flag and will throw a "[SecurityError](#)" [DOMException](#) rather than leak cross-origin data.

The value of the [origin-clean](#) flag is propagated from a source [canvas](#) element's bitmap to a new [ImageBitmap](#) object by [createImageBitmap\(\)](#). Conversely, a destination [canvas](#) element's bitmap will have its [origin-clean](#) flags set to false by [drawImage](#) if the source image is an [ImageBitmap](#) object whose bitmap has its [origin-clean](#) flag set to false.

The flag can be reset in certain situations; for example, when changing the value of the [width](#) or the [height](#) content attribute of the [canvas](#) element to which a [CanvasRenderingContext2D](#) is bound, the bitmap is cleared and its [origin-clean](#) flag is reset.

When using an [ImageBitmapRenderingContext](#), the value of the [origin-clean](#) flag is propagated from [ImageBitmap](#) objects when they are transferred to the [canvas](#) via [transferFromImageBitmap\(\)](#).

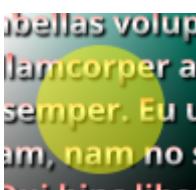
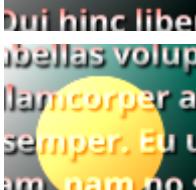
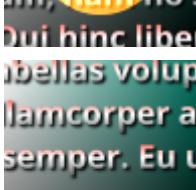
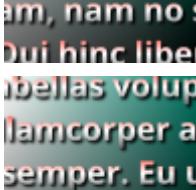
4.12.5.7 Premultiplied alpha and the 2D rendering context

Premultiplied alpha refers to one way of representing transparency in an image, the other being non-premultiplied alpha.

Under non-premultiplied alpha, the red, green, and blue channels of a pixel represent that pixel's color, and its alpha channel represents that pixel's opacity.

Under premultiplied alpha, however, the red, green, and blue channels of a pixel represent the amounts of color that the pixel adds to the image, and its alpha channel represents the amount that the pixel obscures whatever is behind it.

For instance, assuming the color channels range from 0 (off) to 255 (full intensity), these example colors are represented in the following ways:

CSS color representation	Premultiplied representation	Non-premultiplied representation	Description of color	Image of color blended above other content
<code>rgba(255, 127, 0, 1)</code>	<code>255, 127, 0, 255</code>	<code>255, 127, 0, 255</code>	Completely-opaque orange	
<code>rgba(255, 255, 0, 0.5)</code>	<code>127, 127, 0, 127</code>	<code>255, 255, 0, 127</code>	Halfway-opaque yellow	
Unrepresentable	<code>255, 127, 0, 127</code>	Unrepresentable	Additive halfway-opaque orange	
Unrepresentable	<code>255, 127, 0, 0</code>	Unrepresentable	Additive fully-transparent orange	
<code>rgba(255, 127, 0, 0)</code>	<code>0, 0, 0, 0</code>	<code>255, 127, 0, 0</code>	Fully-transparent ("invisible") orange	
<code>rgba(0, 127, 255, 0)</code>	<code>0, 0, 0, 0</code>	<code>255, 127, 0, 0</code>	Fully-transparent ("invisible") turquoise	

Converting a color value from a non-premultiplied representation to a premultiplied one involves multiplying the color's red, green, and blue channels by its alpha channel (remapping the range of the alpha channel such that "fully transparent" is 0, and "fully opaque" is 1).

Converting a color value from a premultiplied representation to a non-premultiplied one involves the inverse: dividing the color's red, green, and blue channels by its alpha channel.

As certain colors can only be represented under premultiplied alpha (for instance, additive colors), and others can only be represented under non-premultiplied alpha (for instance, "invisible" colors which hold certain red, green, and blue values even with no opacity); and division and multiplication on 8-bit integers (which is how canvas's colors are currently stored)

entails a loss of precision, converting between premultiplied and non-premultiplied alpha is a lossy operation on colors that are not fully opaque.

A [CanvasRenderingContext2D](#)'s [output bitmap](#) and an [OffscreenCanvasRenderingContext2D](#)'s [bitmap](#) must use premultiplied alpha to represent transparent colors.

It is important for canvas bitmaps to represent colors using premultiplied alpha because it affects the range of representable colors. While additive colors cannot currently be drawn onto canvases directly because CSS colors are non-premultiplied and cannot represent them, it is still possible to, for instance, draw additive colors onto a WebGL canvas and then draw that WebGL canvas onto a 2D canvas via [drawImage\(\)](#).

4.13 Custom elements



[Using_custom_elements](#)

Support in all current engines.

Firefox 63+ Safari 10.1+ Chrome 54+

Opera 41+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 63+ Safari iOS 10.3+ Chrome Android 54+ WebView Android 54+ Samsung Internet 6.0+ Opera Android 41+

4.13.1 Introduction

This section is non-normative.

[Custom elements](#) provide a way for authors to build their own fully-featured DOM elements. Although authors could always use non-standard elements in their documents, with application-specific behavior added after the fact by scripting or similar, such elements have historically been non-conforming and not very functional. By [defining](#) a custom element, authors can inform the parser how to properly construct an element and how elements of that class should react to changes.

Custom elements are part of a larger effort to "rationalise the platform", by explaining existing platform features (like the elements of HTML) in terms of lower-level author-exposed extensibility points (like custom element definition). Although today there are many limitations on the capabilities of custom elements—both functionally and semantically—that prevent them from fully explaining the behaviors of HTML's existing elements, we hope to shrink this gap over time.

4.13.1.1 Creating an autonomous custom element

This section is non-normative.

For the purposes of illustrating how to create an [autonomous custom element](#), let's define a custom element that encapsulates rendering a small icon for a country flag. Our goal is to be able to use it like so:

```
<flag-icon country="nl"></flag-icon>
```

To do this, we first declare a class for the custom element, extending [HTMLElement](#):

```
class FlagIcon extends HTMLElement {
  constructor() {
    super();
    this._countryCode = null;
  }

  static observedAttributes = ["country"];

  attributeChangedCallback(name, oldValue, newValue) {
    // name will always be "country" due to observedAttributes
    this._countryCode = newValue;
    this._updateRendering();
  }
  connectedCallback() {
    this._updateRendering();
  }

  get country() {
    return this._countryCode;
  }
  set country(v) {
    this.setAttribute("country", v);
  }

  _updateRendering() {
    // Left as an exercise for the reader. But, you'll probably want to
    // check this.ownerDocument.defaultView to see if we've been
    // inserted into a document with a browsing context, and avoid
    // doing any work if not.
  }
}
```

We then need to use this class to define the element:

```
customElements.define("flag-icon", FlagIcon);
```

At this point, our above code will work! The parser, whenever it sees the `flag-icon` tag, will construct a new instance of our `FlagIcon` class, and tell our code about its new `country` attribute, which we then use to set the element's internal state and update its rendering (when appropriate).

You can also create `flag-icon` elements using the DOM API:

```
const flagIcon = document.createElement("flag-icon")
flagIcon.country = "jp"
document.body.appendChild(flagIcon)
```

Finally, we can also use the [custom element constructor](#) itself. That is, the above code is equivalent to:

```
const flagIcon = new FlagIcon()
flagIcon.country = "jp"
document.body.appendChild(flagIcon)
```

4.13.1.2 Creating a form-associated custom element

This section is non-normative.

Adding a static `formAssociated` property, with a true value, makes an [autonomous custom element](#) a [form-associated custom element](#). The [ElementInternals](#) interface helps you to implement functions and properties common to form control elements.

```
class MyCheckbox extends HTMLElement {
  static formAssociated = true;
  static observedAttributes = ['checked'];

  constructor() {
    super();
    this._internals = this.attachInternals();
    this.addEventListener('click', this._onClick.bind(this));
  }

  get form() { return this._internals.form; }
  get name() { return this.getAttribute('name'); }
  get type() { return this.localName; }

  get checked() { return this.hasAttribute('checked'); }
  set checked(flag) { this.toggleAttribute('checked', Boolean(flag)); }

  attributeChangedCallback(name, oldValue, newValue) {
    // name will always be "checked" due to observedAttributes
    this._internals.setFormValue(this.checked ? 'on' : null);
  }
}
```

```

    _onClick(event) {
      this.checked = !this.checked;
    }
}
customElements.define('my-checkbox', MyCheckbox);

```

You can use the custom element `my-checkbox` like a built-in form-associated element. For example, putting it in `form` or `label` associates the `my-checkbox` element with them, and submitting the `form` will send data provided by `my-checkbox` implementation.

```

<form action="..." method="...>
  <label><my-checkbox name="agreed"></my-checkbox> I read the agreement.</label>
  <input type="submit">
</form>

```

4.13.1.3 Creating a custom element with default accessible roles, states, and properties

This section is non-normative.

By using the appropriate properties of [ElementInternals](#), your custom element can have default accessibility semantics. The following code expands our form-associated checkbox from the previous section to properly set its default role and checkedness, as viewed by accessibility technology:

```

class MyCheckbox extends HTMLElement {
  static formAssociated = true;
  static observedAttributes = ['checked'];

  constructor() {
    super();
    this._internals = this.attachInternals();
    this.addEventListener('click', this._onClick.bind(this));

    this._internals.role = 'checkbox';
    this._internals.ariaChecked = false;
  }

  get form() { return this._internals.form; }
  get name() { return this.getAttribute('name'); }
  get type() { return this.localName; }

  get checked() { return this.getAttribute('checked'); }
  set checked(flag) { this.toggleAttribute('checked', Boolean(flag)); }

  attributeChangedCallback(name, oldValue, newValue) {
    // name will always be "checked" due to observedAttributes
  }
}

```

```

    this._internals.setFormValue(this.checked ? 'on' : null);
    this._internals.ariaChecked = this.checked;
}

_onClick(event) {
    this.checked = !this.checked;
}
}
customElements.define('my-checkbox', MyCheckbox);

```

Note that, like for built-in elements, these are only defaults, and can be overridden by the page author using the [role](#) and [aria-*](#) attributes:

```

<!-- This markup is non-conforming -->
<input type="checkbox" checked role="button" aria-checked="false">

<!-- This markup is probably not what the custom element author intended -->
<my-checkbox role="button" checked aria-checked="false">

```

Custom element authors are encouraged to state what aspects of their accessibility semantics are strong native semantics, i.e., should not be overridden by users of the custom element. In our example, the author of the `my-checkbox` element would state that its [role](#) and [aria-checked](#) values are strong native semantics, thus discouraging code such as the above.

4.13.1.4 Creating a customized built-in element

This section is non-normative.

[Customized built-in elements](#) are a distinct kind of [custom element](#), which are defined slightly differently and used very differently compared to [autonomous custom elements](#). They exist to allow reuse of behaviors from the existing elements of HTML, by extending those elements with new custom functionality. This is important since many of the existing behaviors of HTML elements can unfortunately not be duplicated by using purely [autonomous custom elements](#). Instead, [customized built-in elements](#) allow the installation of custom construction behavior, lifecycle hooks, and prototype chain onto existing elements, essentially "mixing in" these capabilities on top of the already-existing element.

[Customized built-in elements](#) require a distinct syntax from [autonomous custom elements](#) because user agents and other software key off an element's local name in order to identify the element's semantics and behavior. That is, the concept of [customized built-in elements](#) building on top of existing behavior depends crucially on the extended elements retaining their original local name.

In this example, we'll be creating a [customized built-in element](#) named `plastic-button`, which behaves like a normal button but gets fancy animation effects added whenever you click on it. We start by defining a class, just like before, although this time we extend [HTMLButtonElement](#) instead of [HTMLElement](#):

```
class PlasticButton extends HTMLElement {  
  constructor() {  
    super();  
  
    this.addEventListener("click", () => {  
      // Draw some fancy animation effects!  
    });  
  }  
}
```

When defining our custom element, we have to also specify the `extends` option:

```
customElements.define("plastic-button", PlasticButton, { extends: "button" })
```

In general, the name of the element being extended cannot be determined simply by looking at what element interface it extends, as many elements share the same interface (such as `q` and `blockquote` both sharing [HTMLQuoteElement](#)).

To construct our [customized built-in element](#) from parsed HTML source text, we use the `is` attribute on a `button` element:

```
<button is="plastic-button">Click Me!</button>
```

Trying to use a [customized built-in element](#) as an [autonomous custom element](#) will *not* work; that is, `<plastic-button>Click me?</plastic-button>` will simply create an [HTMLElement](#) with no special behavior.

If you need to create a customized built-in element programmatically, you can use the following form of [createElement\(\)](#):

```
const plasticButton = document.createElement("button", { is: "plastic-button" });  
plasticButton.textContent = "Click me!";
```

And as before, the constructor will also work:

```
const plasticButton2 = new PlasticButton();  
console.log(plasticButton2.localName); // will output "button"  
console.assert(plasticButton2 instanceof PlasticButton);  
console.assert(plasticButton2 instanceof HTMLElement);
```

Note that when creating a customized built-in element programmatically, the `is` attribute will not be present in the DOM, since it was not explicitly set. However, [it will be added to the output when serializing](#):

```
console.assert(!plasticButton.hasAttribute("is"));  
console.log(plasticButton.outerHTML); // will output '<button is="plastic-but
```

Regardless of how it is created, all of the ways in which [button](#) is special apply to such "plastic buttons" as well: their focus behavior, ability to participate in [form submission](#), the [disabled](#) attribute, and so on.

[Customized built-in elements](#) are designed to allow extension of existing HTML elements that have useful user-agent supplied behavior or APIs. As such, they can only extend existing HTML elements defined in this specification, and cannot extend legacy elements such as [bgsound](#), [blink](#), [isindex](#), [keygen](#), [multicol](#), [nextid](#), or [spacer](#) that have been defined to use [HTMLUnknownElement](#) as their [element interface](#).

One reason for this requirement is future-compatibility: if a [customized built-in element](#) was defined that extended a currently-unknown element, for example [combobox](#), this would prevent this specification from defining a [combobox](#) element in the future, as consumers of the derived [customized built-in element](#) would have come to depend on their base element having no interesting user-agent-supplied behavior.

4.13.1.5 Drawbacks of autonomous custom elements

This section is non-normative.

As specified below, and alluded to above, simply defining and using an element called **taco-button** does not mean that such elements [represent](#) buttons. That is, tools such as web browsers, search engines, or accessibility technology will not automatically treat the resulting element as a button just based on its defined name.

To convey the desired button semantics to a variety of users, while still using an [autonomous custom element](#), a number of techniques would need to be employed:

- The addition of the [tabindex](#) attribute would make the **taco-button** [focusable](#). Note that if the **taco-button** were to become logically disabled, the [tabindex](#) attribute would need to be removed.
- The addition of an ARIA role and various ARIA states and properties helps convey semantics to accessibility technology. For example, setting the [role](#) to "[button](#)" will convey the semantics that this is a button, enabling users to successfully interact with the control using usual button-like interactions in their accessibility technology. Setting the [aria-label](#) property is necessary to give the button an [accessible name](#), instead of having accessibility technology traverse its child text nodes and announce them. And setting the [aria-disabled](#) state to "[true](#)" when the button is logically disabled conveys to accessibility technology the button's disabled state.
- The addition of event handlers to handle commonly-expected button behaviors helps convey the semantics of the button to web browser users. In this case, the most relevant event handler would be one that proxies appropriate [keydown](#) events to become [click](#) events, so that you can activate the button both with keyboard and by clicking.
- In addition to any default visual styling provided for **taco-button** elements, the

visual styling will also need to be updated to reflect changes in logical state, such as becoming disabled; that is, whatever style sheet has rules for `taco-button` will also need to have rules for `taco-button[disabled]`.

With these points in mind, a full-featured `taco-button` that took on the responsibility of conveying button semantics (including the ability to be disabled) might look something like this:

```
class TacoButton extends HTMLElement {
  static observedAttributes = ["disabled"];

  constructor() {
    super();
    this._internals = this.attachInternals();
    this._internals.role = "button";

    this.addEventListener("keydown", e => {
      if (e.code === "Enter" || e.code === "Space") {
        this.dispatchEvent(new PointerEvent("click", {
          bubbles: true,
          cancelable: true
        }));
      }
    });
  }

  this.addEventListener("click", e => {
    if (this.disabled) {
      e.preventDefault();
      e.stopImmediatePropagation();
    }
  });
}

this._observer = new MutationObserver(() => {
  this._internals.ariaLabel = this.textContent;
});
}

connectedCallback() {
  this.setAttribute("tabindex", "0");

  this._observer.observe(this, {
    childList: true,
    characterData: true,
    subtree: true
  });
}
```

```

disconnectedCallback() {
  this._observer.disconnect();
}

get disabled() {
  return this.hasAttribute("disabled");
}
set disabled(flag) {
  this.toggleAttribute("disabled", Boolean(flag));
}

attributeChangedCallback(name, oldValue, newValue) {
  // name will always be "disabled" due to observedAttributes
  if (this.disabled) {
    this.removeAttribute("tabindex");
    this._internals.ariaDisabled = "true";
  } else {
    this.setAttribute("tabindex", "0");
    this._internals.ariaDisabled = "false";
  }
}
}

```

Even with this rather-complicated element definition, the element is not a pleasure to use for consumers: it will be continually "sprouting" [tabindex](#) attributes of its own volition, and its choice of `tabindex="0"` focusability behavior may not match the [button](#) behavior on the current platform. This is because as of now there is no way to specify default focus behavior for custom elements, forcing the use of the [tabindex](#) attribute to do so (even though it is usually reserved for allowing the consumer to override default behavior).

In contrast, a simple [customized built-in element](#), as shown in the previous section, would automatically inherit the semantics and behavior of the [button](#) element, with no need to implement these behaviors manually. In general, for any elements with nontrivial behavior and semantics that build on top of existing elements of HTML, [customized built-in elements](#) will be easier to develop, maintain, and consume.

4.13.1.6 Upgrading elements after their creation

This section is non-normative.

Because [element definition](#) can occur at any time, a non-custom element could be [created](#), and then later become a [custom element](#) after an appropriate [definition](#) is registered. We call this process "upgrading" the element, from a normal element into a custom element.

[Upgrades](#) enable scenarios where it may be preferable for [custom element definitions](#) to be registered after relevant elements have been initially created, such as by the parser. They allow progressive enhancement of the content in the custom element. For example, in the following

HTML document the element definition for `img-viewer` is loaded asynchronously:

```
<!DOCTYPE html>
<html lang="en">
<title>Image viewer example</title>

<img-viewer filter="Kelvin">
  
</img-viewer>

<script src="js/elements/img-viewer.js" async></script>
```

The definition for the `img-viewer` element here is loaded using a `script` element marked with the `async` attribute, placed after the `<img-viewer>` tag in the markup. While the script is loading, the `img-viewer` element will be treated as an undefined element, similar to a `span`. Once the script loads, it will define the `img-viewer` element, and the existing `img-viewer` element on the page will be upgraded, applying the custom element's definition (which presumably includes applying an image filter identified by the string "Kelvin", enhancing the image's visual appearance).

Note that [upgrades](#) only apply to elements in the document tree. (Formally, elements that are [connected](#).) An element that is not inserted into a document will stay un-upgraded. An example illustrates this point:

```
<!DOCTYPE html>
<html lang="en">
<title>Upgrade edge-cases example</title>

<example-element></example-element>

<script>
  "use strict";

  const inDocument = document.querySelector("example-element");
  const outOfDocument = document.createElement("example-element");

  // Before the element definition, both are HTMLElement:
  console.assert(inDocument instanceof HTMLElement);
  console.assert(outOfDocument instanceof HTMLElement);

  class ExampleElement extends HTMLElement {}
  customElements.define("example-element", ExampleElement);

  // After element definition, the in-document element was upgraded:
  console.assert(inDocument instanceof ExampleElement);
  console.assert(!(outOfDocument instanceof ExampleElement));
```

```
document.body.appendChild(outOfDocument);

// Now that we've moved the element into the document, it too was upgraded:
console.assert(outOfDocument instanceof ExampleElement);
</script>
```

4.13.2 Requirements for custom element constructors and reactions

When authoring [custom element constructors](#), authors are bound by the following conformance requirements:

- A parameter-less call to `super()` must be the first statement in the constructor body, to establish the correct prototype chain and `this` value before any further code is run.
- A `return` statement must not appear anywhere inside the constructor body, unless it is a simple early-return (`return` or `return this`).
- The constructor must not use the `document.write()` or `document.open()` methods.
- The element's attributes and children must not be inspected, as in the non-[upgrade](#) case none will be present, and relying on upgrades makes the element less usable.
- The element must not gain any attributes or children, as this violates the expectations of consumers who use the `createElement` or `createElementNS` methods.
- In general, work should be deferred to `connectedCallback` as much as possible—especially work involving fetching resources or rendering. However, note that `connectedCallback` can be called more than once, so any initialization work that is truly one-time will need a guard to prevent it from running twice.
- In general, the constructor should be used to set up initial state and default values, and to set up event listeners and possibly a [shadow root](#).

Several of these requirements are checked during [element creation](#), either directly or indirectly, and failing to follow them will result in a custom element that cannot be instantiated by the parser or DOM APIs. This is true even if the work is done inside a constructor-initiated [microtask](#), as a [microtask checkpoint](#) can occur immediately after construction.

When authoring [custom element reactions](#), authors should avoid manipulating the node tree as this can lead to unexpected results.

An element's `connectedCallback` can be queued before the element is disconnected, but as the callback queue is still processed, it results in a `connectedCallback` for an element that is no longer connected:

```

class CParent extends HTMLElement {
  connectedCallback() {
    this.firstChild.remove();
  }
}
customElements.define("c-parent", CParent);

class CChild extends HTMLElement {
  connectedCallback() {
    console.log("CChild connectedCallback: isConnected =", this.isConnected());
  }
}
customElements.define("c-child", CChild);

const parent = new CParent(),
      child = new CChild();
parent.append(child);
document.body.append(parent);

// Logs:
// CChild connectedCallback: isConnected = false

```

4.13.3 Core concepts

A *custom element* is an element that is [custom](#). Informally, this means that its constructor and prototype are defined by the author, instead of by the user agent. This author-supplied constructor function is called the *custom element constructor*.

Two distinct types of [custom elements](#) can be defined:

MDN

[Global_attributes/is](#)

Firefox 63+ Safari No Chrome 67+

Opera 54+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 63+ Safari iOS No Chrome Android 67+ WebView Android 67+ Samsung Internet 9.0+ Opera Android 48+

1. An *autonomous custom element*, which is defined with no **extends** option. These types of custom elements have a local name equal to their [defined name](#).
2. A *customized built-in element*, which is defined with an **extends** option. These types of custom elements have a local name equal to the value passed in their **extends** option, and their [defined name](#) is used as the value of the **is** attribute, which therefore must be

a [valid custom element name](#).

After a [custom element](#) is [created](#), changing the value of the [is](#) attribute does not change the element's behavior, as it is saved on the element as its [is value](#).

[Autonomous custom elements](#) have the following element definition:

[Categories](#):

[Flow content](#).

[Phrasing content](#).

[Palpable content](#).

For [form-associated custom elements](#): [Listed](#), [labelable](#), [submittable](#), and [resettable form-associated element](#).

[Contexts in which this element can be used](#):

Where [phrasing content](#) is expected.

[Content model](#):

[Transparent](#).

[Content attributes](#):

[Global attributes](#), except the [is](#) attribute

[form](#), for [form-associated custom elements](#) — Associates the element with a [form](#) element

[disabled](#), for [form-associated custom elements](#) — Whether the form control is disabled

[readonly](#), for [form-associated custom elements](#) — Affects [willValidate](#), plus any behavior added by the custom element author

[name](#), for [form-associated custom elements](#) — Name of the element to use for [form submission](#) and in the [form.elements](#) API

Any other attribute that has no namespace (see prose).

[Accessibility considerations](#):

For [form-associated custom elements](#): [for authors](#); [for implementers](#).

Otherwise: [for authors](#); [for implementers](#).

[DOM interface](#):

Supplied by the element's author (inherits from [HTMLElement](#))

An [autonomous custom element](#) does not have any special meaning: it [represents](#) its children. A [customized built-in element](#) inherits the semantics of the element that it extends.

Any namespace-less attribute that is relevant to the element's functioning, as determined by the element's author, may be specified on an [autonomous custom element](#), so long as the attribute name is [XML-compatible](#) and contains no [ASCII upper alphas](#). The exception is the [is](#) attribute, which must not be specified on an [autonomous custom element](#) (and which will have no effect if it is).

[Customized built-in elements](#) follow the normal requirements for attributes, based on the elements they extend. To add custom attribute-based behavior, use [data-*](#) attributes.

An [autonomous custom element](#) is called a *form-associated custom element* if the element is associated with a [custom element definition](#) whose [form-associated](#) field is set to true.

The [name](#) attribute represents the [form-associated custom element](#)'s name. The [disabled](#) attribute is used to make the [form-associated custom element](#) non-interactive and to prevent its [submission value](#) from being submitted. The [form](#) attribute is used to explicitly associate the [form-associated custom element](#) with its [form owner](#).

The [readonly](#) attribute of [form-associated custom elements](#) specifies that the element is [barred from constraint validation](#). User agents don't provide any other behavior for the attribute, but custom element authors should, where possible, use its presence to make their control non-editable in some appropriate fashion, similar to the behavior for the [readonly](#) attribute on built-in form controls.

Constraint validation: If the [readonly](#) attribute is specified on a [form-associated custom element](#), the element is [barred from constraint validation](#).

The [reset algorithm](#) for [form-associated custom elements](#) is to [enqueue a custom element callback reaction](#) with the element, callback name "`formResetCallback`", and an empty argument list.

A *valid custom element name* is a sequence of characters *name* that meets all of the following requirements:

- *name* must match the [PotentialCustomElementName](#) production:

```
PotentialCustomElementName ::=  
[a-z] (PCENChar)* '-' (PCENChar)*  
  
PCENChar ::=  
"- " | ". ." | "[0-9]" | "_" | [a-z] | #xB7 | [#xC0-#xD6] |  
[#xD8-#xF6] | [#xF8-#x37D] | [#x37F-#x1FFF] | [#x200C-#x200D]  
| [#x203F-#x2040] | [#x2070-#x218F] | [#x2C00-#x2FEF] |  
[#x3001-#xD7FF] | [#xF900-#xFDCF] | [#xFDF0-#xFFFF] |  
[#x10000-#xEFFFF]
```

This uses the [EBNF notation](#) from the XML specification. [\[XML\]](#)

- *name* must not be any of the following:

- `annotation-xml`
- `color-profile`
- `font-face`
- `font-face-src`
- `font-face-uri`
- `font-face-format`
- `font-face-name`
- `missing-glyph`

The list of names above is the summary of all hyphen-containing element names from the [applicable specifications](#), namely *SVG 2* and *MathML*. [\[SVG\]](#) [\[MATHML\]](#)

These requirements ensure a number of goals for [valid custom element names](#):

- They start with an [ASCII lower alpha](#), ensuring that the HTML parser will treat them as tags instead of as text.
- They do not contain any [ASCII upper alphas](#), ensuring that the user agent can always treat HTML elements ASCII-case-insensitively.
- They contain a hyphen, used for namespacing and to ensure forward compatibility (since no elements will be added to HTML, SVG, or MathML with hyphen-containing local names in the future).
- They can always be created with [createElement\(\)](#) and [createElementNS\(\)](#), which have restrictions that go beyond the parser's.

Apart from these restrictions, a large variety of names is allowed, to give maximum flexibility for use cases like `<math-α>` or `<emotion-😊>`.

A *custom element definition* describes a [custom element](#) and consists of:

A *name*

A [valid custom element name](#)

A *local name*

A local name

A *constructor*

A Web IDL [CustomElementConstructor](#) callback function type value wrapping the [custom element constructor](#)

A list of *observed attributes*

A sequence<DOMString>

A collection of *lifecycle callbacks*

A map, whose keys are the strings "connectedCallback", "disconnectedCallback", "adoptedCallback", "attributeChangedCallback", "formAssociatedCallback", "formDisabledCallback", "formResetCallback", and "formStateRestoreCallback". The corresponding values are either a Web IDL [Function](#) callback function type value, or null. By default the value of each entry is null.

A *construction stack*

A list, initially empty, that is manipulated by the [upgrade an element](#) algorithm and the [HTML element constructors](#). Each entry in the list will be either an element or an *already constructed marker*.

A *form-associated boolean*

If this is true, user agent treats elements associated to this [custom element definition](#) as [form-associated custom elements](#).

A *disable internals boolean*

Controls [attachInternals\(\)](#).

A *disable shadow boolean*

Controls [attachShadow\(\)](#).

To *look up a custom element definition*, given a *document*, *namespace*, *localName*, and *is*, perform the following steps. They will return either a [custom element definition](#) or null:

1. If *namespace* is not the [HTML namespace](#), return null.
2. If *document's browsing context* is null, return null.
3. Let *registry* be *document's relevant global object*'s [CustomElementRegistry](#) object.
4. If there is [custom element definition](#) in *registry* with [name](#) and [local name](#) both equal to *localName*, return that [custom element definition](#).
5. If there is a [custom element definition](#) in *registry* with [name](#) equal to *is* and [local name](#) equal to *localName*, return that [custom element definition](#).
6. Return null.

4.13.4 The [CustomElementRegistry](#) interface



[CustomElementRegistry](#)

Support in all current engines.

Firefox63+Safari10.1+Chrome54+

Opera41+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS10.3+Chrome Android54+WebView Android54+Samsung Internet6.0+Opera Android41+

Each [Window](#) object is associated with a unique instance of a [CustomElementRegistry](#) object, allocated when the [Window](#) object is created.

Custom element registries are associated with [Window](#) objects, instead of [Document](#) objects, since each [custom element constructor](#) inherits from the [HTMLElement](#) interface, and there is exactly one [HTMLElement](#) interface per [Window](#) object.



[Window/customElements](#)

Support in all current engines.

Firefox63+Safari10.1+Chrome54+

Opera41+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS10.3+Chrome Android54+WebView Android54+Samsung Internet6.0+Opera Android41+

The *customElements* attribute of the [Window](#) interface must return the [CustomElementRegistry](#) object for that [Window](#) object.

```
[Exposed=Window]
interface CustomElementRegistry {
  [CEReactions] undefined define(DOMString name, CustomElementConstructor con
  (CustomElementConstructor or undefined) get(DOMString name);
  Promise<CustomElementConstructor> whenDefined(DOMString name);
  [CEReactions] undefined upgrade(Node root);
};

callback CustomElementConstructor = HTMLElement ();

dictionary ElementDefinitionOptions {
  DOMString extends;
};
```

Every [CustomElementRegistry](#) has a set of [custom element definitions](#), initially empty. In general, algorithms in this specification look up elements in the registry by any of [name](#), [local name](#), or [constructor](#).

Every [CustomElementRegistry](#) also has an *element definition is running* flag which is used to prevent reentrant invocations of [element definition](#). It is initially unset.

Every [CustomElementRegistry](#) also has a *when-defined promise map*, mapping [valid](#) custom element names to promises. It is used to implement the [whenDefined\(\)](#) method.

`window.customElements.define(name, constructor)`

✓MDN

[CustomElementRegistry/define](#)

Support in all current engines.

Firefox63+Safari10.1+Chrome67+

Opera54+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS10.3+Chrome Android67+WebView Android67+Samsung Internet9.0+Opera Android48+

Defines a new [custom element](#), mapping the given name to the given constructor as an [autonomous custom element](#).

`window.customElements.define(name, constructor, { extends: baseLocalName })`

Defines a new [custom element](#), mapping the given name to the given constructor as a [customized built-in element](#) for the [element type](#) identified by the supplied `baseLocalName`. A ["NotSupportedError" DOMException](#) will be thrown upon trying to extend a [custom element](#) or an unknown element.

`window.customElements.get(name)`

✓MDN

[CustomElementRegistry/get](#)

Support in all current engines.

Firefox63+Safari10.1+Chrome67+

Opera54+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS10.3+Chrome Android67+WebView Android67+Samsung Internet9.0+Opera Android48+

Retrieves the [custom element constructor](#) defined for the given `name`. Returns undefined if there is no [custom element definition](#) with the given `name`.

`window.customElements.whenDefined(name)`

✓MDN

[CustomElementRegistry/whenDefined](#)

Support in all current engines.

Firefox63+Safari10.1+Chrome67+

Opera54+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS10.3+Chrome Android67+WebView Android67+Samsung Internet9.0+Opera Android48+

Returns a promise that will be fulfilled with the [custom element](#)'s constructor when a [custom element](#) becomes defined with the given name. (If such a [custom element](#) is already defined, the returned promise will be immediately fulfilled.) Returns a promise rejected with a "[SyntaxError](#)" [DOMException](#) if not given a [valid custom element name](#).

[window.customElements.upgrade\(root\)](#)



[CustomElementRegistry/upgrade](#)

Support in all current engines.

Firefox63+Safari12.1+Chrome68+

Opera55+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android63+Safari iOS12.2+Chrome Android68+WebView Android68+Samsung Internet10.0+Opera Android48+

Tries to upgrade all [shadow-including inclusive descendant](#) elements of *root*, even if they are not [connected](#).

Element definition is a process of adding a [custom element definition](#) to the [CustomElementRegistry](#). This is accomplished by the [define\(\)](#) method. When invoked, the [define\(name, constructor, options\)](#) method must run these steps:

1. If [IsConstructor](#)(*constructor*) is false, then throw a [TypeError](#).
2. If *name* is not a [valid custom element name](#), then throw a "[SyntaxError](#)" [DOMException](#).
3. If this [CustomElementRegistry](#) contains an entry with [name](#) *name*, then throw a "[NotSupportedError](#)" [DOMException](#).
4. If this [CustomElementRegistry](#) contains an entry with [constructor](#) *constructor*, then throw a "[NotSupportedError](#)" [DOMException](#).
5. Let *localName* be *name*.

6. Let *extends* be the value of the **extends** member of *options*, or null if no such member exists.
7. If *extends* is not null, then:
 1. If *extends* is a [valid custom element name](#), then throw a ["NotSupportedError" DOMException](#).
 2. If the [element interface](#) for *extends* and the [HTML namespace](#) is [HTMLUnknownElement](#) (e.g., if *extends* does not indicate an element definition in this specification), then throw a ["NotSupportedError" DOMException](#).
 3. Set *localName* to *extends*.
8. If this [CustomElementRegistry](#)'s [element definition is running](#) flag is set, then throw a ["NotSupportedError" DOMException](#).
9. Set this [CustomElementRegistry](#)'s [element definition is running](#) flag.
10. Let *formAssociated* be false.
11. Let *disableInternals* be false.
12. Let *disableShadow* be false.
13. Let *observedAttributes* be an empty **sequence<DOMString>**.
14. Run the following substeps while catching any exceptions:
 1. Let *prototype* be [Get](#)(*constructor*, "prototype"). Rethrow any exceptions.
 2. If [Type](#)(*prototype*) is not Object, then throw a [TypeError](#) exception.
 3. Let *lifecycleCallbacks* be a map with the keys "**connectedCallback**", "**disconnectedCallback**", "**adoptedCallback**", and "**attributeChangedCallback**", each of which belongs to an entry whose value is null.
 4. For each of the keys *callbackName* in *lifecycleCallbacks*, in the order listed in the previous step:
 1. Let *callbackValue* be [Get](#)(*prototype*, *callbackName*). Rethrow any exceptions.
 2. If *callbackValue* is not undefined, then set the value of the entry in *lifecycleCallbacks* with key *callbackName* to the result of [converting](#) *callbackValue* to the Web IDL [Function](#) callback type. Rethrow any exceptions from the conversion.

5. If the value of the entry in *lifecycleCallbacks* with key "**attributeChangedCallback**" is not null, then:
 1. Let *observedAttributesIterable* be [Get](#)(*constructor*, "observedAttributes"). Rethrow any exceptions.
 2. If *observedAttributesIterable* is not undefined, then set *observedAttributes* to the result of [converting](#) *observedAttributesIterable* to a **sequence<DOMString>**. Rethrow any exceptions from the conversion.
6. Let *disabledFeatures* be an empty **sequence<DOMString>**.
7. Let *disabledFeaturesIterable* be [Get](#)(*constructor*, "disabledFeatures"). Rethrow any exceptions.
8. If *disabledFeaturesIterable* is not undefined, then set *disabledFeatures* to the result of [converting](#) *disabledFeaturesIterable* to a **sequence<DOMString>**. Rethrow any exceptions from the conversion.
9. Set *disableInternals* to true if *disabledFeatures* [contains](#) "internals".
10. Set *disableShadow* to true if *disabledFeatures* [contains](#) "shadow".
11. Let *formAssociatedValue* be [Get](#)(*constructor*, "formAssociated"). Rethrow any exceptions.
12. Set *formAssociated* to the result of [converting](#) *formAssociatedValue* to a **boolean**. Rethrow any exceptions from the conversion.
13. If *formAssociated* is true, for each of "**formAssociatedCallback**", "**formResetCallback**", "**formDisabledCallback**", and "**formStateRestoreCallback**" *callbackName*:
 1. Let *callbackValue* be [Get](#)(*prototype*, *callbackName*). Rethrow any exceptions.
 2. If *callbackValue* is not undefined, then set the value of the entry in *lifecycleCallbacks* with key *callbackName* to the result of [converting](#) *callbackValue* to the Web IDL **Function** callback type. Rethrow any exceptions from the conversion.

Then, perform the following substep, regardless of whether the above steps threw an exception or not:

1. Unset this [**CustomElementRegistry**](#)'s [element definition is running](#) flag.

Finally, if the first set of substeps threw an exception, then rethrow that exception (thus terminating this algorithm). Otherwise, continue onward.

15. Let *definition* be a new [custom element definition](#) with [name](#) *name*, [local name](#) *localName*, [constructor](#) *constructor*, [observed attributes](#) *observedAttributes*, [lifecycle callbacks](#) *lifecycleCallbacks*, [form-associated](#) *formAssociated*, [disable internals](#) *disableInternals*, and [disable shadow](#) *disableShadow*.
16. Add *definition* to this [CustomElementRegistry](#).
17. Let *document* be this [CustomElementRegistry](#)'s [relevant global object](#)'s [associated Document](#).
18. Let *upgrade candidates* be all elements that are [shadow-including descendants](#) of *document*, whose namespace is the [HTML namespace](#) and whose local name is *localName*, in [shadow-including tree order](#). Additionally, if *extends* is non-null, only include elements whose [is value](#) is equal to *name*.
19. For each element *element* in *upgrade candidates*, [enqueue a custom element upgrade reaction](#) given *element* and *definition*.
20. If this [CustomElementRegistry](#)'s [when-defined promise map](#) contains an entry with key *name*:
 1. Let *promise* be the value of that entry.
 2. Resolve *promise* with *constructor*.
 3. Delete the entry with key *name* from this [CustomElementRegistry](#)'s [when-defined promise map](#).

When invoked, the [get\(name\)](#) method must run these steps:

1. If this [CustomElementRegistry](#) contains an entry with [name](#) *name*, then return that entry's [constructor](#).
2. Otherwise, return undefined.

When invoked, the [whenDefined\(name\)](#) method must run these steps:

1. If *name* is not a [valid custom element name](#), then return a new promise rejected with a "[SyntaxError](#)" [DOMException](#).
2. If this [CustomElementRegistry](#) contains an entry with [name](#) *name*, then return a new promise resolved with that entry's [constructor](#).
3. Let *map* be this [CustomElementRegistry](#)'s [when-defined promise map](#).

4. If *map* does not contain an entry with key *name*, create an entry in *map* with key *name* and whose value is a new promise.
5. Let *promise* be the value of the entry in *map* with key *name*.
6. Return *promise*.

The [whenDefined\(\)](#) method can be used to avoid performing an action until all appropriate [custom elements](#) are [defined](#). In this example, we combine it with the [:defined](#) pseudo-class to hide a dynamically-loaded article's contents until we're sure that all of the [autonomous custom elements](#) it uses are defined.

```
articleContainer.hidden = true;

fetch(articleURL)
  .then(response => response.text())
  .then(text => {
    articleContainer.innerHTML = text;

    return Promise.all(
      [...articleContainer.querySelectorAll(":not(:defined)")]
        .map(el => customElements.whenDefined(el.localName)))
  );
})
.then(() => {
  articleContainer.hidden = false;
});
```

When invoked, the *upgrade(root)* method must run these steps:

1. Let *candidates* be a [list](#) of all of *root*'s [shadow-including inclusive descendant](#) elements, in [shadow-including tree order](#).
2. [For each](#) *candidate* of *candidates*, [try to upgrade](#) *candidate*.

The [upgrade\(\)](#) method allows upgrading of elements at will. Normally elements are automatically upgraded when they become [connected](#), but this method can be used if you need to upgrade before you're ready to connect the element.

```
const el = document.createElement("spider-man");

class SpiderMan extends HTMLElement {}
customElements.define("spider-man", SpiderMan);

console.assert(!(el instanceof SpiderMan)); // not yet upgraded
customElements.upgrade(el);
```

```
console.assert(el instanceof SpiderMan); // upgraded!
```

4.13.5 Upgrades

To upgrade an element, given as input a [custom element definition](#) *definition* and an element *element*, run the following steps:

1. If *element*'s [custom element state](#) is not "undefined" or "uncustomized", then return.

One scenario where this can occur due to reentrant invocation of this algorithm, as in the following example:

```
<!DOCTYPE html>
<x-foo id="a"></x-foo>
<x-foo id="b"></x-foo>

<script>
// Defining enqueues upgrade reactions for both "a" and "b"
customElements.define("x-foo", class extends HTMLElement {
    constructor() {
        super();

        const b = document.querySelector("#b");
        b.remove();

        // While this constructor is running for "a", "b" is still
        // undefined, and so inserting it into the document will enqueue a
        // second upgrade reaction for "b" in addition to the one enqueued
        // by defining x-foo.
        document.body.appendChild(b);
    }
})
</script>
```

This step will thus bail out the algorithm early when [upgrade an element](#) is invoked with "b" a second time.

2. Set *element*'s [custom element definition](#) to *definition*.
3. Set *element*'s [custom element state](#) to "failed".

It will be set to "custom" [after the upgrade succeeds](#). For now, we set it to "failed" so that any reentrant invocations will hit [the above early-exit step](#).

4. For each *attribute* in *element*'s [attribute list](#), in order, [enqueue a custom element callback reaction](#) with *element*, callback name "attributeChangedCallback", and

an argument list containing *attribute*'s local name, null, *attribute*'s value, and *attribute*'s namespace.

5. If *element* is [connected](#), then [enqueue a custom element callback reaction](#) with *element*, callback name "connectedCallback", and an empty argument list.
6. Add *element* to the end of *definition*'s [construction stack](#).
7. Let *C* be *definition*'s [constructor](#).
8. Run the following substeps while catching any exceptions:
 1. If *definition*'s [disable shadow](#) is true and *element*'s [shadow root](#) is non-null, then throw a ["NotSupportedError" DOMException](#).

This is needed as [attachShadow\(\)](#) does not use [look up a custom element definition](#) while [attachInternals\(\)](#) does.
 2. Set *element*'s [custom element state](#) to "precustomized".
 3. Let *constructResult* be the result of [constructing](#) *C*, with no arguments.

If *C* [non-conformantly](#) uses an API decorated with the [\[CEReactions\]](#) extended attribute, then the reactions enqueued at the beginning of this algorithm will execute during this step, before *C* finishes and control returns to this algorithm. Otherwise, they will execute after *C* and the rest of the upgrade process finishes.
 4. If [SameValue](#)(*constructResult*, *element*) is false, then throw a [TypeError](#).

This can occur if *C* constructs another instance of the same custom element before calling [super\(\)](#), or if *C* uses JavaScript's [return](#)-override feature to return an arbitrary [HTMLElement](#) object from the constructor.

Then, perform the following substep, regardless of whether the above steps threw an exception or not:

1. Remove the last entry from the end of *definition*'s [construction stack](#).

Assuming *C* calls [super\(\)](#) (as it will if it is [conformant](#)), and that the call succeeds, this will be the [already constructed marker](#) that replaced the *element* we pushed at the beginning of this algorithm. (The [HTML element constructor](#) carries out this replacement.)

If *C* does not call [super\(\)](#) (i.e. it is not [conformant](#)), or if any step in the [HTML element constructor](#) throws, then this entry will still be *element*.

Finally, if the above steps threw an exception, then:

1. Set *element*'s [custom element definition](#) to null.
2. Empty *element*'s [custom element reaction queue](#).
3. Rethrow the exception (thus terminating this algorithm).

If the above steps threw an exception, then *element*'s [custom element state](#) will remain "failed" or "precustomized".

9. If *element* is a [form-associated custom element](#), then:
 1. [Reset the form owner](#) of *element*. If *element* is associated with a [form](#) element, then [enqueue a custom element callback reaction](#) with *element*, callback name "formAssociatedCallback", and « the associated [form](#) ».
 2. If *element* is [disabled](#), then [enqueue a custom element callback reaction](#) with *element*, callback name "formDisabledCallback" and « true ».
10. Set *element*'s [custom element state](#) to "custom".

To try to upgrade an *element*, given as input an element *element*, run the following steps:

1. Let *definition* be the result of [looking up a custom element definition](#) given *element*'s [node document](#), *element*'s namespace, *element*'s local name, and *element*'s [is value](#).
2. If *definition* is not null, then [enqueue a custom element upgrade reaction](#) given *element* and *definition*.

4.13.6 Custom element reactions

A [custom element](#) possesses the ability to respond to certain occurrences by running author code:

- When [upgraded](#), its [constructor](#) is run, with no arguments.
- When it [becomes connected](#), its [connectedCallback](#) is called, with no arguments.
- When it [becomes disconnected](#), its [disconnectedCallback](#) is called, with no arguments.
- When it is [adopted](#) into a new document, its [adoptedCallback](#) is called, given the old document and new document as arguments.
- When any of its attributes are [changed](#), [appended](#), [removed](#), or [replaced](#), its [attributeChangedCallback](#) is called, given the attribute's local name, old value, new value, and namespace as arguments. (An attribute's old or new value is considered to be null when the attribute is added or removed, respectively.)

- When the user agent [resets the form owner](#) of a [form-associated custom element](#) and doing so changes the form owner, its `formAssociatedCallback` is called, given the new form owner (or null if no owner) as an argument.
- When the form owner of a [form-associated custom element](#) is [reset](#), its `formResetCallback` is called.
- When the [disabled](#) state of a [form-associated custom element](#) is changed, its `formDisabledCallback` is called, given the new state as an argument.
- When user agent updates a [form-associated custom element](#)'s value on behalf of a user or [as part of navigation](#), its `formStateRestoreCallback` is called, given the new value and a string indicating a reason, "autocomplete" or "restore", as arguments.

We call these reactions collectively *custom element reactions*.

The way in which [custom element reactions](#) are invoked is done with special care, to avoid running author code during the middle of delicate operations. Effectively, they are delayed until "just before returning to user script". This means that for most purposes they appear to execute synchronously, but in the case of complicated composite operations (like [cloning](#), or [range manipulation](#)), they will instead be delayed until after all the relevant user agent processing steps have completed, and then run together as a batch.

Additionally, the precise ordering of these reactions is managed via a somewhat-complicated stack-of-queues system, described below. The intention behind this system is to guarantee that [custom element reactions](#) always are invoked in the same order as their triggering actions, at least within the local context of a single [custom element](#). (Because [custom element reaction](#) code can perform its own mutations, it is not possible to give a global ordering guarantee across multiple elements.)

Each [similar-origin window agent](#) has a *custom element reactions stack*, which is initially empty. A [similar-origin window agent](#)'s *current element queue* is the [element queue](#) at the top of its [custom element reactions stack](#). Each item in the stack is an *element queue*, which is initially empty as well. Each item in an [element queue](#) is an element. (The elements are not necessarily [custom](#) yet, since this queue is used for [upgrades](#) as well.)

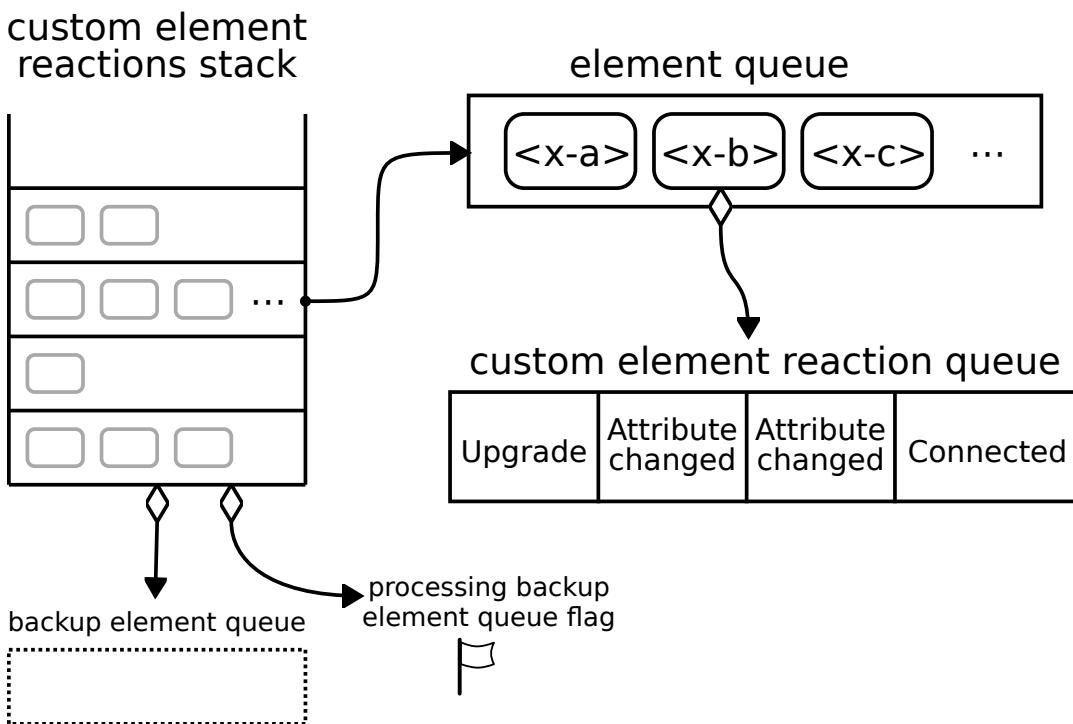
Each [custom element reactions stack](#) has an associated *backup element queue*, which an initially-empty [element queue](#). Elements are pushed onto the [backup element queue](#) during operations that affect the DOM without going through an API decorated with [\[CEReactions\]](#), or through the parser's [create an element for the token](#) algorithm. An example of this is a user-initiated editing operation which modifies the descendants or attributes of an [editable](#) element. To prevent reentrancy when processing the [backup element queue](#), each [custom element reactions stack](#) also has a *processing the backup element queue* flag, initially unset.

All elements have an associated *custom element reaction queue*, initially empty. Each item in

the [custom element reaction queue](#) is of one of two types:

- An *upgrade reaction*, which will [upgrade](#) the custom element and contains a [custom element definition](#); or
- A *callback reaction*, which will call a lifecycle callback, and contains a callback function as well as a list of arguments.

This is all summarized in the following schematic diagram:



To enqueue an element on the appropriate element queue, given an element *element*, run the following steps:

1. Let *reactionsStack* be *element*'s [relevant agent's custom element reactions stack](#).
2. If *reactionsStack* is empty, then:
 1. Add *element* to *reactionsStack*'s [backup element queue](#).
 2. If *reactionsStack*'s [processing the backup element queue](#) flag is set, then return.
 3. Set *reactionsStack*'s [processing the backup element queue](#) flag.
 4. [Queue a microtask](#) to perform the following steps:
 1. [Invoke custom element reactions](#) in *reactionsStack*'s [backup element queue](#).

2. Unset *reactionsStack*'s [processing the backup element queue](#) flag.
3. Otherwise, add *element* to *element*'s [relevant agent](#)'s [current element queue](#).

To *enqueue a custom element callback reaction*, given a [custom element](#) *element*, a callback name *callbackName*, and a list of arguments *args*, run the following steps:

1. Let *definition* be *element*'s [custom element definition](#).
2. Let *callback* be the value of the entry in *definition*'s [lifecycle callbacks](#) with key *callbackName*.
3. If *callback* is null, then return.
4. If *callbackName* is "attributeChangedCallback", then:
 1. Let *attributeName* be the first element of *args*.
 2. If *definition*'s [observed attributes](#) does not contain *attributeName*, then return.
5. Add a new [callback reaction](#) to *element*'s [custom element reaction queue](#), with callback function *callback* and arguments *args*.
6. [Enqueue an element on the appropriate element queue](#) given *element*.

To *enqueue a custom element upgrade reaction*, given an element *element* and [custom element definition](#) *definition*, run the following steps:

1. Add a new [upgrade reaction](#) to *element*'s [custom element reaction queue](#), with [custom element definition](#) *definition*.
2. [Enqueue an element on the appropriate element queue](#) given *element*.

To *invoke custom element reactions* in an [element queue](#) *queue*, run the following steps:

1. While *queue* is not [empty](#):
 1. Let *element* be the result of [dequeuing](#) from *queue*.
 2. Let *reactions* be *element*'s [custom element reaction queue](#).
 3. Repeat until *reactions* is empty:
 1. Remove the first element of *reactions*, and let *reaction* be that element. Switch on *reaction*'s type:
 - [upgrade reaction](#)
[Upgrade](#) *element* using *reaction*'s [custom element definition](#).

[callback reaction](#)

[Invoke](#) *reaction*'s callback function with *reaction*'s arguments, and with *element* as the [callback this value](#).

If this throws an exception, catch it, and [report the exception](#).

To ensure [custom element reactions](#) are triggered appropriately, we introduce the [\[CEReactions\]](#) IDL [extended attribute](#). It indicates that the relevant algorithm is to be supplemented with additional steps in order to appropriately track and invoke [custom element reactions](#).

The [\[CEReactions\]](#) extended attribute must take no arguments, and must not appear on anything other than an operation, attribute, setter, or deleter. Additionally, it must not appear on readonly attributes.

Operations, attributes, setters, or deleters annotated with the [\[CEReactions\]](#) extended attribute must run the following steps in place of the ones specified in their description:

1. [Push](#) a new [element queue](#) onto this object's [relevant agent's custom element reactions stack](#).
2. Run the originally-specified steps for this construct, catching any exceptions. If the steps return a value, let *value* be the returned value. If they throw an exception, let *exception* be the thrown exception.
3. Let *queue* be the result of [popping](#) from this object's [relevant agent's custom element reactions stack](#).
4. [Invoke custom element reactions](#) in *queue*.
5. If an exception *exception* was thrown by the original steps, rethrow *exception*.
6. If a value *value* was returned from the original steps, return *value*.

The intent behind this extended attribute is somewhat subtle. One way of accomplishing its goals would be to say that every operation, attribute, setter, and deleter on the platform must have these steps inserted, and to allow implementers to optimize away unnecessary cases (where no DOM mutation is possible that could cause [custom element reactions](#) to occur).

However, in practice this imprecision could lead to non-interoperable implementations of [custom element reactions](#), as some implementations might forget to invoke these steps in some cases. Instead, we settled on the approach of explicitly annotating all relevant IDL constructs, as a way of ensuring interoperable behavior and helping implementations easily pinpoint all cases where these steps are necessary.

Any nonstandard APIs introduced by the user agent that could modify the DOM in such a way as to cause [enqueueing a custom element callback reaction](#) or [enqueueing a custom element](#)

[upgrade reaction](#), for example by modifying any attributes or child elements, must also be decorated with the [\[CEReactions\]](#) attribute.

As of the time of this writing, the following nonstandard or not-yet-standardized APIs are known to fall into this category:

- [HTMLInputElement](#)'s `webkitdirectory` and `incremental` IDL attributes
- [HTMLLinkElement](#)'s `scope` IDL attribute

4.13.7 Element internals

Certain capabilities are meant to be available to a custom element author, but not to a custom element consumer. These are provided by the [element.attachInternals\(\)](#) method, which returns an instance of [ElementInternals](#). The properties and methods of [ElementInternals](#) allow control over internal features which the user agent provides to all elements.

[element.attachInternals\(\)](#)

Returns an [ElementInternals](#) object targeting the [custom element](#) `element`. Throws an exception if `element` is not a [custom element](#), if the "internals" feature was disabled as part of the element definition, or if it is called twice on the same element.

Each [HTMLElement](#) has an *attached internals* boolean, initially false.

MDN

[HTMLElement/attachInternals](#)

Firefox 93+ Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 93+ Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

The `attachInternals()` method steps are:

1. If `this`'s `is value` is not null, then throw a "[NotSupportedError](#)" [DOMException](#).
2. Let `definition` be the result of [looking up a custom element definition](#) given this's [node document](#), its namespace, its local name, and null as the `is value`.
3. If `definition` is null, then throw an "[NotSupportedError](#)" [DOMException](#).
4. If `definition`'s `disable internals` is true, then throw a "[NotSupportedError](#)"

[DOMException](#).

5. If `this`'s `attached internals` is true, then throw an "[NotSupportedError](#)" [DOMException](#)".
6. If `this`'s `custom element state` is not "precustomized" or "custom", then throw a "[NotSupportedError](#)" [DOMException](#)".
7. Set `this`'s `attached internals` to true.
8. Return a new [ElementInternals](#) instance whose `target element` is `this`.

4.13.7.1 The [ElementInternals](#) interface

MDN

[ElementInternals](#)

Firefox93+SafariNoChrome77+

Opera64+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android93+Safari iOSNoChrome Android77+WebView Android77+Samsung Internet12.0+Opera Android55+

The IDL for the [ElementInternals](#) interface is as follows, with the various operations and attributes defined in the following sections:

```
[Exposed=Window]
interface ElementInternals {
    // Shadow root access
    readonly attribute ShadowRoot? shadowRoot;

    // Form-associated custom elements
    undefined setFormValue((File or USVString or FormData)? value,
                           optional (File or USVString or FormData)? state);

    readonly attribute HTMLFormElement? form;

    undefined setValidity(optional ValidityStateFlags flags = {},
                           optional DOMString message,
                           optional HTMLElement anchor);
    readonly attribute boolean willValidate;
    readonly attribute ValidityState validity;
    readonly attribute DOMString validationMessage;
    boolean checkValidity();
    boolean reportValidity();
```

```

    readonly attribute NodeList labels;
};

// Accessibility semantics
ElementInternals includes ARIAMixin;

dictionary ValidityStateFlags {
    boolean valueMissing = false;
    boolean typeMismatch = false;
    boolean patternMismatch = false;
    boolean tooLong = false;
    boolean tooShort = false;
    boolean rangeUnderflow = false;
    boolean rangeOverflow = false;
    boolean stepMismatch = false;
    boolean badInput = false;
    boolean customError = false;
};

```

Each [ElementInternals](#) has a *target element*, which is a [custom element](#).

4.13.7.2 Shadow root access

[*internals.shadowRoot*](#)

Returns the [ShadowRoot](#) for *internals's target element*, if the [target element](#) is a [shadow host](#), or null otherwise.

MDN

[ElementInternals/shadowRoot](#)

Firefox93+SafariNoChrome77+

Opera64+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android93+Safari iOSNoChrome Android77+WebView Android77+Samsung Internet12.0+Opera Android55+

The *shadowRoot* getter steps are:

1. Let *target* be *this*'s [target element](#).
2. If *target* is not a [shadow host](#), then return null.
3. Let *shadow* be *target*'s [shadow root](#).

4. If *shadow*'s [available to element internals](#) is false, then return null.
5. Return *shadow*.

4.13.7.3 Form-associated custom elements

internals.setFormValue(value)

Sets both the [state](#) and [submission value](#) of *internals*'s [target element](#) to *value*.

If *value* is null, the element won't participate in form submission.

internals.setFormValue(value, state)

Sets the [submission value](#) of *internals*'s [target element](#) to *value*, and its [state](#) to *state*.

If *value* is null, the element won't participate in form submission.

internals.form

Returns the [form owner](#) of *internals*'s [target element](#).

internals.setValidity(flags, message [, anchor])

Marks *internals*'s [target element](#) as suffering from the constraints indicated by the *flags* argument, and sets the element's validation message to *message*. If *anchor* is specified, the user agent might use it to indicate problems with the constraints of *internals*'s [target element](#) when the [form owner](#) is validated interactively or [reportValidity\(\)](#) is called.

internals.setValidity({})

Marks *internals*'s [target element](#) as [satisfying its constraints](#).

internals . willValidate

Returns true if *internals*'s [target element](#) will be validated when the form is submitted; false otherwise.

internals.validity

Returns the [ValidityState](#) object for *internals*'s [target element](#).

internals . validationMessage

Returns the error message that would be shown to the user if *internals*'s [target element](#) was to be checked for validity.

`valid = internals . checkValidity()`

Returns true if *internals*'s [target element](#) has no validity problems; false otherwise. Fires an [invalid](#) event at the element in the latter case.

`valid = internals . reportValidity()`

Returns true if *internals*'s [target element](#) has no validity problems; otherwise, returns false, fires an [invalid](#) event at the element, and (if the event isn't canceled) reports the problem to the user.

`internals.labels`

Returns a [NodeList](#) of all the [label](#) elements that *internals*'s [target element](#) is associated with.

Each [form-associated custom element](#) has [submission value](#). It is used to provide one or more [entries](#) on form submission. The initial value of [submission value](#) is null, and [submission value](#) can be null, a string, a [File](#), or a [list](#) of [entries](#).

Each [form-associated custom element](#) has [state](#). It is information with which the user agent can restore a user's input for the element. The initial value of [state](#) is null, and [state](#) can be null, a string, a [File](#), or a [list](#) of [entries](#).

The [setFormValue\(\)](#) method is used by the custom element author to set the element's [submission value](#) and [state](#), thus communicating these to the user agent.

When the user agent believes it is a good idea to restore a [form-associated custom element](#)'s [state](#), for example [after navigation](#) or restarting the user agent, they may [enqueue a custom element callback reaction](#) with that element, callback name "`formStateRestoreCallback`", an argument list containing the state to be restored, and "`restore`".

If the user agent has a form-filling assist feature, then when the feature is invoked, it may [enqueue a custom element callback reaction](#) with a [form-associated custom element](#), callback name "`formStateRestoreCallback`", an argument list containing the state value determined by history of state value and some heuristics, and "`autocomplete`".

In general, the [state](#) is information specified by a user, and the [submission value](#) is a value after canonicalization or sanitization, suitable for submission to the server. The following examples makes this concrete:

Suppose that we have a [form-associated custom element](#) which asks a user to specify a date. The user specifies "3/15/2019", but the control wishes to submit "2019-03-15" to the server. "3/15/2019" would be a [state](#) of the element, and "2019-03-15" would be a [submission value](#).

Suppose you develop a custom element emulating the behavior of the existing [checkbox](#)

[input](#) type. Its [submission value](#) would be the value of its [value](#) content attribute, or the string "on". Its [state](#) would be one of "checked", "unchecked", "checked/indeterminate", or "unchecked/indeterminate".

MDN

[ElementInternals/setFormValue](#)

Firefox 95+ Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

The `setFormValue(value, state)` method steps are:

1. Let `element` be [this's target element](#).
2. If `element` is not a [form-associated custom element](#), then throw a ["NotSupportedError" DOMException](#).
3. Set [target element's submission value](#) to `value` if `value` is not a [FormData](#) object, or to a [clone](#) of the entry list associated with `value` otherwise.
4. If the `state` argument of the function is omitted, set `element's state` to its [submission value](#).
5. Otherwise, if `state` is a [FormData](#) object, set `element's state` to [clone](#) of the entry list associated with `state`.
6. Otherwise, set `element's state` to `state`.

Each [form-associated custom element](#) has validity flags named `valueMissing`, `typeMismatch`, `patternMismatch`, `tooLong`, `tooShort`, `rangeUnderflow`, `rangeOverflow`, `stepMismatch`, and `customError`. They are false initially.

Each [form-associated custom element](#) has a `validation message` string. It is the empty string initially.

Each [form-associated custom element](#) has a `validation anchor` element. It is null initially.

MDN

[ElementInternals/setValidity](#)

Support in one engine only.

Firefox No Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung

Internet 12.0+ Opera Android 55+

The `setValidity(flags, message, anchor)` method steps are:

1. Let `element` be `this`'s [target element](#).
2. If `element` is not a [form-associated custom element](#), then throw a ["NotSupportedError" DOMException](#).
3. If `flags` contains one or more true values and `message` is not given or is the empty string, then throw a [TypeError](#).
4. For each entry `flag → value` of `flags`, set `element`'s validity flag with the name `flag` to `value`.
5. Set `element`'s [validation message](#) to the empty string if `message` is not given or all of `element`'s validity flags are false, or to `message` otherwise.
6. If `element`'s `customError` validity flag is true, then set `element`'s [custom validity error message](#) to `element`'s [validation message](#). Otherwise, set `element`'s [custom validity error message](#) to the empty string.
7. Set `element`'s [validation anchor](#) to null if `anchor` is not given. Otherwise, if `anchor` is not a [shadow-including descendant](#) of `element`, then throw a ["NotFoundError" DOMException](#). Otherwise, set `element`'s [validation anchor](#) to `anchor`.

ΔMDN

[ElementInternals/validationMessage](#)

Support in one engine only.

Firefox No Safari No Chrome 77+

Opera 64+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android No Safari iOS No Chrome Android 77+ WebView Android 77+ Samsung

Internet 12.0+ Opera Android 55+

The `validationMessage` getter steps are:

1. Let *element* be *this*'s [target element](#).
2. If *element* is not a [form-associated custom element](#), then throw a ["NotSupportedError" DOMException](#).
3. Return *element*'s [validation message](#).

The *entry construction algorithm* for a [form-associated custom element](#), given an element *element* and a list *entry list*, consists of the following steps:

1. If *element*'s [submission value](#) is a [list](#) of [entries](#), then [append](#) each item of *element*'s [submission value](#) to *entry list*, and return.

In this case, user agent does not refer to the [name](#) content attribute value. An implementation of [form-associated custom element](#) is responsible to decide names of [entries](#). They can be the [name](#) content attribute value, they can be strings based on the [name](#) content attribute value, or they can be unrelated to the [name](#) content attribute.

2. If the element does not have a [name](#) attribute specified, or its [name](#) attribute's value is the empty string, then return.
3. If the element's [submission value](#) is not null, [append an entry](#) to *entry list* with the [name](#) attribute value and the [submission value](#).

4.13.7.4 Accessibility semantics

`internals.role [= value]`

Sets or retrieves the default ARIA role for *internals*'s [target element](#), which will be used unless the page author overrides it using the [role](#) attribute.

`internals.aria* [= value]`

Sets or retrieves various default ARIA states or property values for *internals*'s [target element](#), which will be used unless the page author overrides them using the [aria-*](#) attributes.

Each [custom element](#) has a *native accessibility semantics map*, which is a [map](#), initially empty. See the [Requirements related to ARIA and to platform accessibility APIs](#) section for information on how this impacts platform accessibility APIs.

[ElementInternals](#) includes the [ARIAMixin](#) mixin. The accessors provided by this mixin are used to manipulate the [target element's native accessibility semantics map](#), as follows:

The [ARIAMixin getter steps](#) for [ElementInternals](#), given *internals*, *idlAttribute*, and *contentAttribute*, are:

1. Let *map* be *internals*'s [target element](#)'s [native accessibility semantics map](#).
2. If *map*[*contentAttribute*] [exists](#), then return it.
3. Return null.

The [ARIAMixin](#) [setter steps](#) for [ElementInternals](#), given *internals*, *idlAttribute*, *contentAttribute*, and *value*, are:

1. Let *map* be *internals*'s [target element](#)'s [native accessibility semantics map](#).
2. If *value* is null, then [remove](#) *map*[*contentAttribute*].
3. Otherwise, [set](#) *map*[*contentAttribute*] to *value*.

4.14 Common idioms without dedicated elements

4.14.1 Breadcrumb navigation

This specification does not provide a machine-readable way of describing breadcrumb navigation menus. Authors are encouraged to just use a series of links in a paragraph. The [nav](#) element can be used to mark the section containing these paragraphs as being navigation blocks.

In the following example, the current page can be reached via two paths.

```
<nav>
  <p>
    <a href="/">Main</a> ▶
    <a href="/products/">Products</a> ▶
    <a href="/products/dishwashers/">Dishwashers</a> ▶
    <a>Second hand</a>
  </p>
  <p>
    <a href="/">Main</a> ▶
    <a href="/second-hand/">Second hand</a> ▶
    <a>Dishwashers</a>
  </p>
</nav>
```

4.14.2 Tag clouds

This specification does not define any markup specifically for marking up lists of keywords that apply to a group of pages (also known as *tag clouds*). In general, authors are encouraged to either mark up such lists using [ul](#) elements with explicit inline counts that are then hidden and turned into a presentational effect using a style sheet, or to use SVG.

Here, three tags are included in a short tag cloud:

```
<style>
.tag-cloud > li > span { display: none; }
.tag-cloud > li { display: inline; }
.tag-cloud-1 { font-size: 0.7em; }
.tag-cloud-2 { font-size: 0.9em; }
.tag-cloud-3 { font-size: 1.1em; }
.tag-cloud-4 { font-size: 1.3em; }
.tag-cloud-5 { font-size: 1.5em; }

@media speech {
    .tag-cloud > li > span { display:inline }
}
</style>
...
<ul class="tag-cloud">
    <li class="tag-cloud-4"><a title="28 instances" href="/t/apple">apple</a> <span>
        <li class="tag-cloud-2"><a title="6 instances" href="/t/kiwi">kiwi</a> <span>
            <li class="tag-cloud-5"><a title="41 instances" href="/t/pear">pear</a> <span>
</ul>
```

The actual frequency of each tag is given using the `title` attribute. A CSS style sheet is provided to convert the markup into a cloud of differently-sized words, but for user agents that do not support CSS or are not visual, the markup contains annotations like "(popular)" or "(rare)" to categorize the various tags by frequency, thus enabling all users to benefit from the information.

The `ul` element is used (rather than `ol`) because the order is not particularly important: while the list is in fact ordered alphabetically, it would convey the same information if ordered by, say, the length of the tag.

The `tag rel`-keyword is *not* used on these `a` elements because they do not represent tags that apply to the page itself; they are just part of an index listing the tags themselves.

4.14.3 Conversations

This specification does not define a specific element for marking up conversations, meeting minutes, chat transcripts, dialogues in screenplays, instant message logs, and other situations where different players take turns in discourse.

Instead, authors are encouraged to mark up conversations using `p` elements and punctuation. Authors who need to mark the speaker for styling purposes are encouraged to use `span` or `b`. Paragraphs with their text wrapped in the `i` element can be used for marking up stage directions.

This example demonstrates this using an extract from Abbot and Costello's famous sketch,

Who's on first:

```
<p> Costello: Look, you gotta first baseman?  
<p> Abbott: Certainly.  
<p> Costello: Who's playing first?  
<p> Abbott: That's right.  
<p> Costello becomes exasperated.  
<p> Costello: When you pay off the first baseman every month, who gets the mo  
<p> Abbott: Every dollar of it.
```

The following extract shows how an IM conversation log could be marked up, using the [data](#) element to provide Unix timestamps for each line. Note that the timestamps are provided in a format that the [time](#) element does not support, so the [data](#) element is used instead (namely, Unix [time_t](#) timestamps). Had the author wished to mark up the data using one of the date and time formats supported by the [time](#) element, that element could have been used instead of [data](#). This could be advantageous as it would allow data analysis tools to detect the timestamps unambiguously, without coordination with the page author.

```
<p> <data value="1319898155">14:22</data> <b>egof</b> I'm not that nerdy, I've  
<p> <data value="1319898192">14:23</data> <b>kaj</b> if you know what percenta  
<p> <data value="1319898200">14:23</data> <b>egof</b> it's unarguably  
<p> <data value="1319898228">14:23</data> <i>* kaj blinks</i>  
<p> <data value="1319898260">14:24</data> <b>kaj</b> you are not helping your
```

HTML does not have a good way to mark up graphs, so descriptions of interactive conversations from games are more difficult to mark up. This example shows one possible convention using [dl](#) elements to list the possible responses at each point in the conversation. Another option to consider is describing the conversation in the form of a DOT file, and outputting the result as an SVG image to place in the document. [\[DOT\]](#)

```
<p> Next, you meet a fisher. You can say one of several greetings:  
<dl>  
  <dt> "Hello there!"  
  <dd>  
    <p> She responds with "Hello, how may I help you?"; you can respond with:  
    <dl>  
      <dt> "I would like to buy a fish."  
      <dd> <p> She sells you a fish and the conversation finishes.  
      <dt> "Can I borrow your boat?"  
      <dd>  
        <p> She is surprised and asks "What are you offering in return?".  
        <dl>  
          <dt> "Five gold." (if you have enough)  
          <dt> "Ten gold." (if you have enough)  
          <dt> "Fifteen gold." (if you have enough)  
          <dd> <p> She lends you her boat. The conversation ends.  
          <dt> "A fish." (if you have one)
```

```

<dt> "A newspaper." (if you have one)
<dt> "A pebble." (if you have one)
<dd> <p> "No thanks", she replies. Your conversation options
at this point are the same as they were after asking to borrow
her boat, minus any options you've suggested before.
</dl>
</dd>
</dl>
</dd>
<dt> "Vote for me in the next election!"
<dd> <p> She turns away. The conversation finishes.
<dt> "Madam, are you aware that your fish are running away?"
<dd>
<p> She looks at you skeptically and says "Fish cannot run, miss".
<dl>
<dt> "You got me!"
<dd> <p> The fisher sighs and the conversation ends.
<dt> "Only kidding."
<dd> <p> "Good one!" she retorts. Your conversation options at this
point are the same as those following "Hello there!" above.
<dt> "Oh, then what are they doing?"
<dd> <p> She looks at her fish, giving you an opportunity to steal
her boat, which you do. The conversation ends.
</dl>
</dd>
</dl>

```

In some games, conversations are simpler: each character merely has a fixed set of lines that they say. In this example, a game FAQ/walkthrough lists some of the known possible responses for each character:

```

<section>
<h1>Dialogue</h1>
<p><small>Some characters repeat their lines in order each time you interact
with them, others randomly pick from amongst their lines. Those who respond
in order have numbered entries in the lists below.</small>
<h2>The Shopkeeper</h2>
<ul>
<li>How may I help you?
<li>Fresh apples!
<li>A loaf of bread for madam?
</ul>
<h2>The pilot</h2>
<p>Before the accident:
<ul>
<li>I'm about to fly out, sorry!
<li>Sorry, I'm just waiting for flight clearance and then I'll be off!

```

```

</ul>
<p>After the accident:
<ol>
  <li>I'm about to fly out, sorry!
  <li>Ok, I'm not leaving right now, my plane is being cleaned.
  <li>Ok, it's not being cleaned, it needs a minor repair first.
  <li>Ok, ok, stop bothering me! Truth is, I had a crash.
</ol>
<h2>Clan Leader</h2>
<p>During the first clan meeting:
<ul>
  <li>Hey, have you seen my daughter? I bet she's up to something nefarious a
  <li>Nice weather we're having today, eh?
  <li>The name is Bailey, Jeff Bailey. How can I help you today?
  <li>A glass of water? Fresh from the well!
</ul>
<p>After the earthquake:
<ol>
  <li>Everyone is safe in the shelter, we just have to put out the fire!
  <li>I'll go and tell the fire brigade, you keep hosing it down!
</ol>
</section>

```

4.14.4 Footnotes

HTML does not have a dedicated mechanism for marking up footnotes. Here are the suggested alternatives.

For short inline annotations, the [title](#) attribute could be used.

In this example, two parts of a dialogue are annotated with footnote-like content using the [title](#) attribute.

```

<p> <b>Customer</b>: Hello! I wish to register a complaint. Hello. Miss?
<p> <b>Shopkeeper</b>: <span title="Colloquial pronunciation of 'What do you'">Wwatcha</span> mean, miss?
<p> <b>Customer</b>: Uh, I'm sorry, I have a cold. I wish to make a complaint
<p> <b>Shopkeeper</b>: Sorry, <span title="This is, of course, a lie.">we're
closing for lunch</span>.

```

Unfortunately, relying on the [title](#) attribute is currently discouraged as many user agents do not expose the attribute in an accessible manner as required by this specification (e.g. requiring a pointing device such as a mouse to cause a tooltip to appear, which excludes keyboard-only users and touch-only users, such as anyone with a modern phone or tablet).

If the [title](#) attribute is used, CSS can be used to draw the reader's attention to the elements

with the attribute.

For example, the following CSS places a dashed line below elements that have a `title` attribute.

```
[title] { border-bottom: thin dashed; }
```

For longer annotations, the `a` element should be used, pointing to an element later in the document. The convention is that the contents of the link be a number in square brackets.

In this example, a footnote in the dialogue links to a paragraph below the dialogue. The paragraph then reciprocally links back to the dialogue, allowing the user to return to the location of the footnote.

```
<p> Announcer: Number 16: The <i>hand</i>.  
<p> Interviewer: Good evening. I have with me in the studio tonight  
Mr Norman St John Polevaulter, who for the past few years has been  
contradicting people. Mr Polevaulter, why <em>do</em> you  
contradict people?  
<p> Norman: I don't. <sup><a href="#fn1" id="r1">[1]</a></sup>  
<p> Interviewer: You told me you did!  
...  
<section>  
  <p id="fn1"><a href="#r1">[1]</a> This is, naturally, a lie,  
  but paradoxically if it were true he could not say so without  
  contradicting the interviewer and thus making it false.</p>  
</section>
```

For side notes, longer annotations that apply to entire sections of the text rather than just specific words or sentences, the `aside` element should be used.

In this example, a sidebar is given after a dialogue, giving it some context.

```
<p> <span class="speaker">Customer</span>: I will not buy this record, it is :  
<p> <span class="speaker">Shopkeeper</span>: I'm sorry?  
<p> <span class="speaker">Customer</span>: I will not buy this record, it is :  
<p> <span class="speaker">Shopkeeper</span>: No no no, this's'a tobacconist's  
<aside>  
  <p>In 1970, the British Empire lay in ruins, and foreign  
  nationalists frequented the streets – many of them Hungarians  
  (not the streets – the foreign nationals). Sadly, Alexander  
  Yalt has been publishing incompetently-written phrase books.  
</aside>
```

For figures or tables, footnotes can be included in the relevant [figcaption](#) or [caption](#) element, or in surrounding prose.

In this example, a table has cells with footnotes that are given in prose. A [figure](#) element is used to give a single legend to the combination of the table and its footnotes.

```
<figure>
  <figcaption>Table 1. Alternative activities for knights.</figcaption>
  <table>
    <tr>
      <th> Activity
      <th> Location
      <th> Cost
    <tr>
      <td> Dance
      <td> Wherever possible
      <td> £0<a href="#fn1">1</a></sup>
    <tr>
      <td> Routines, chorus scenes<a href="#fn2">2</a></sup>
      <td> Undisclosed
      <td> Undisclosed
    <tr>
      <td> Dining<a href="#fn3">3</a></sup>
      <td> Camelot
      <td> Cost of ham, jam, and spam<a href="#fn4">4</a></sup>
    </table>
    <p id="fn1">1. Assumed.</p>
    <p id="fn2">2. Footwork impeccable.</p>
    <p id="fn3">3. Quality described as "well".</p>
    <p id="fn4">4. A lot.</p>
  </figure>
```

4.15 Disabled elements

An element is said to be *actually disabled* if it is one of the following:

- a [button](#) element that is [disabled](#)
- an [input](#) element that is [disabled](#)
- a [select](#) element that is [disabled](#)
- a [textarea](#) element that is [disabled](#)
- an [optgroup](#) element that has a [disabled](#) attribute
- an [option](#) element that is [disabled](#)
- a [fieldset](#) element that is a [disabled fieldset](#)
- a [form-associated custom element](#) that is [disabled](#)

This definition is used to determine what elements are [focusable](#) and which elements match the [:enabled](#) and [:disabled](#) pseudo classes.

4.16 Matching HTML elements using selectors and CSS

4.16.1 Case-sensitivity of the CSS '[attr\(\)](#)' function

CSS Values and Units leaves the case-sensitivity of attribute names for the purpose of the '[attr\(\)](#)' function to be defined by the host language. [\[CSSVALUES\]](#)

When comparing the attribute name part of a CSS '[attr\(\)](#)' function to the names of namespace-less attributes on [HTML elements](#) in [HTML documents](#), the name part of the CSS '[attr\(\)](#)' function must first be [converted to ASCII lowercase](#). The same function when compared to other attributes must be compared according to its original case. In both cases, to match the values must be [identical to](#) each other (and therefore the comparison is case sensitive).

This is the same as comparing the name part of a CSS [attribute selector](#), specified in the next section.

4.16.2 Case-sensitivity of selectors

Selectors leaves the case-sensitivity of element names, attribute names, and attribute values to be defined by the host language. [\[SELECTORS\]](#)

When comparing a CSS element [type selector](#) to the names of [HTML elements](#) in [HTML documents](#), the CSS element [type selector](#) must first be [converted to ASCII lowercase](#). The same selector when compared to other elements must be compared according to its original case. In both cases, to match the values must be [identical to](#) each other (and therefore the comparison is case sensitive).

When comparing the name part of a CSS [attribute selector](#) to the names of attributes on [HTML elements](#) in [HTML documents](#), the name part of the CSS [attribute selector](#) must first be [converted to ASCII lowercase](#). The same selector when compared to other attributes must be compared according to its original case. In both cases, the comparison is case-sensitive.

[Attribute selectors](#) on an [HTML element](#) in an [HTML document](#) must treat the *values* of attributes with the following names as [ASCII case-insensitive](#):

- accept
- accept-charset
- align
- alink
- axis
- bgcolor
- charset
- checked
- clear
- codetype
- color

- compact
- declare
- defer
- dir
- direction
- disabled
- enctype
- face
- frame
- hreflang
- http-equiv
- lang
- language
- link
- media
- method
- multiple
- nohref
- noresize
- noshade
- nowrap
- readonly
- rel
- rev
- rules
- scope
- scrolling
- selected
- shape
- target
- text
- type
- valign
- valuetype
- vlink

For example, the selector `[bgcolor="#ffffff"]` will match any HTML element with a `bgcolor` attribute with values including `#ffffff`, `#FFFFFF` and `#ffffFFF`. This happens even if `bgcolor` has no effect for a given element (e.g., [div](#)).

The selector `[type=a s]` will match any HTML element with a `type` attribute whose value is `a`, but not whose value is `A`, due to the `s` flag.

All other attribute values and everything else must be treated as entirely [identical to](#) each other for the purposes of selector matching. This includes:

- [IDs](#) and [classes](#) in [no-quirks mode](#) and [limited-quirks mode](#)
- the names of elements not in the [HTML namespace](#)
- the names of [HTML elements](#) in [XML documents](#)
- the names of attributes of elements not in the [HTML namespace](#)
- the names of attributes of [HTML elements](#) in [XML documents](#)
- the names of attributes that themselves have namespaces

Selectors defines that ID and class selectors (such as `#foo` and `.bar`), when matched against elements in documents that are in [quirks mode](#), will be matched in an [ASCII case-insensitive](#) manner. However, this does not apply for attribute selectors with "id" or "class" as the name part. The selector `[class="foobar"]` will treat its value as case-sensitive even in [quirks mode](#).

4.16.3 Pseudo-classes

MDN

[Pseudo-classes](#)

There are a number of dynamic selectors that can be used with HTML. This section defines when these selectors match HTML elements. [\[SELECTORS\]](#) [\[CSSUI\]](#)

:defined

✓MDN

[:defined](#)

Support in all current engines.

Firefox 63+ Safari 10+ Chrome 54+

Opera 41+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 63+ Safari iOS 10+ Chrome Android 54+ WebView Android 54+ Samsung Internet 6.0+ Opera Android 41+

The [:defined pseudo-class](#) must match any element that is [defined](#).

:link

✓MDN

[:link](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera3.5+Edge79+

Edge (Legacy)12+Internet Explorer3+

Firefox Android4+Safari iOS3.2+Chrome Android18+WebView Android1.5+Samsung

Internet1.0+Opera Android14+

:visited

✓MDN

[:visited](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera3.5+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android4.4+Samsung

Internet1.0+Opera Android10.1+

All [a](#) elements that have an [href](#) attribute, and all [area](#) elements that have an [href](#) attribute, must match one of [:link](#) and [:visited](#).

Other specifications might apply more specific rules regarding how these elements are to match these [pseudo-classes](#), to mitigate some privacy concerns that apply with straightforward implementations of this requirement.

:active

✓MDN

[:active](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera5+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android10.1+

The [:active](#) [pseudo-class](#) is defined to match an element “while an element is *being activated* by the user”.

To determine whether a particular element is [being activated](#) for the purposes of defining the [:active](#) [pseudo-class](#) only, an HTML user agent must use the first relevant entry in the following list.

If the element has a descendant that is currently matching the [:active](#) pseudo-class

The element is *being activated*.

If the element is the [labeled control](#) of a [label](#) element that is currently matching [:active](#)

The element is *being activated*.

If the element is a [button](#) element

If the element is an [input](#) element whose [type](#) attribute is in the [Submit Button](#), [Image Button](#), [Reset Button](#), or [Button](#) state

The element is *being activated* if it is in a formal activation state and it is not disabled.

For example, if the user is using a keyboard to push a [button](#) element by pressing the space bar, the element would match this [pseudo-class](#) in between the time that the element received the [keydown](#) event and the time the element received the [keyup](#) event.

If the element is an [a](#) element that has an [href](#) attribute

If the element is an [area](#) element that has an [href](#) attribute

If the element is a [link](#) element that has an [href](#) attribute

If the element is [focusable](#)

The element is *being activated* if it is in a formal activation state.

If the element is [being actively pointed at](#)

The element is *being activated*.

An element is said to be *in a formal activation state* between the time the user begins to indicate an intent to trigger the element's [activation behavior](#) and either the time the user stops indicating an intent to trigger the element's [activation behavior](#), or the time the element's [activation behavior](#) has finished running, which ever comes first.

An element is said to be *being actively pointed at* while the user indicates the element using a pointing device while that pointing device is in the "down" state (e.g. for a mouse, between the time the mouse button is pressed and the time it is depressed; for a finger in a multitouch environment, while the finger is touching the display surface).

:hover

✓MDN

[:hover](#)

Support in all current engines.

Firefox1+Safari2+Chrome1+

Opera4+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

The [:hover pseudo-class](#) is defined to match an element “while the user designates an element with a pointing device”. For the purposes of defining the [:hover pseudo-class](#) only, an HTML user agent must consider an element as being one that the user designates if it is:

- An element that the user indicates using a pointing device.
- An element that has a descendant that the user indicates using a pointing device.
- An element that is the [labeled control](#) of a [label](#) element that is currently matching [:hover](#).

Consider in particular a fragment such as:

```
<p> <label for=c> <input id=a> </label> <span id=b> <input id=c> </span> <
```

If the user designates the element with ID “a” with their pointing device, then the [p](#) element (and all its ancestors not shown in the snippet above), the [label](#) element, the element with ID “a”, and the element with ID “c” will match the [:hover pseudo-class](#). The element with ID “a” matches it from condition 1, the [label](#) and [p](#) elements match it because of condition 2 (one of their descendants is designated), and the element with ID “c” matches it through condition 3 (its [label](#) element matches [:hover](#)). However, the element with ID “b” does *not* match [:hover](#): its descendant is not designated, even though it matches [:hover](#).

:focus



[:focus](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera7+Edge79+

Edge (Legacy)12+Internet Explorer8+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

For the purposes of the CSS [:focus pseudo-class](#), an *element has the focus* when:

- it is not itself a [browsing context container](#); and
- at least one of the following is true:
 - it is one of the elements listed in the [current focus chain of the top-level browsing context](#), or
 - its [shadow root](#) `shadowRoot` is not null and `shadowRoot` is the [root](#) of at least one element that [has the focus](#).

:target

✓MDN

[:target](#)

Support in all current engines.

Firefox 1+ Safari 1.3+ Chrome 1+

Opera 9.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 2+ Samsung Internet 1.0+ Opera Android 10.1+

For the purposes of the CSS [:target](#) pseudo-class, the [Document](#)'s *target elements* are a list containing the [Document](#)'s [target element](#), if it is not null, or containing no elements, if it is. [\[SELECTORS\]](#)

:enabled

✓MDN

[:enabled](#)

Support in all current engines.

Firefox 1+ Safari 3.1+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 2+ Samsung Internet 1.0+ Opera Android 10.1+

The [:enabled](#) pseudo-class must match any [button](#), [input](#), [select](#), [textarea](#), [optgroup](#), [option](#), [fieldset](#) element, or [form-associated custom element](#) that is not [actually disabled](#).

:disabled



[:disabled](#)

Support in all current engines.

Firefox 1+ Safari 3.1+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 2+ Samsung Internet 1.0+ Opera Android 10.1+

The [:disabled pseudo-class](#) must match any element that is [actually disabled](#).

[:checked](#)



[:checked](#)

Support in all current engines.

Firefox 1+ Safari 3.1+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 2+ Samsung Internet 1.0+ Opera Android 10.1+

The [:checked pseudo-class](#) must match any element falling into one of the following categories:

- [input](#) elements whose [type](#) attribute is in the [Checkbox](#) state and whose [checkedness](#) state is true
- [input](#) elements whose [type](#) attribute is in the [Radio Button](#) state and whose [checkedness](#) state is true
- [option](#) elements whose [selectedness](#) is true

[:indeterminate](#)



[:indeterminate](#)

Support in all current engines.

Firefox 2+ Safari 3+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy)12+Internet Explorer10+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android10.1+

The [:indeterminate pseudo-class](#) must match any element falling into one of the following categories:

- [input](#) elements whose [type](#) attribute is in the [Checkbox](#) state and whose [indeterminate](#) IDL attribute is set to true
- [input](#) elements whose [type](#) attribute is in the [Radio Button](#) state and whose [radio button group](#) contains no [input](#) elements whose [checkedness](#) state is true.
- [progress](#) elements with no [value](#) content attribute

:default



[:default](#)

Support in all current engines.

Firefox4+Safari5+Chrome10+

Opera10+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android10.1+

The [:default pseudo-class](#) must match any element falling into one of the following categories:

- [Submit buttons](#) that are [default buttons](#) of their [form owner](#).
- [input](#) elements to which the [checked](#) attribute applies and that have a [checked](#) attribute
- [option](#) elements that have a [selected](#) attribute

:placeholder-shown

The [:placeholder-shown pseudo-class](#) must match any element falling into one of the following categories:

- [input](#) elements that have a [placeholder](#) attribute whose value is currently being presented to the user.
- [textarea](#) elements that have a [placeholder](#) attribute whose value is currently being presented to the user.

:valid



:valid

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 10+

Opera 10+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

The [:valid pseudo-class](#) must match any element falling into one of the following categories:

- elements that are [candidates for constraint validation](#) and that [satisfy their constraints](#)
- [form](#) elements that are not the [form owner](#) of any elements that themselves are [candidates for constraint validation](#) but do not [satisfy their constraints](#)
- [fieldset](#) elements that have no descendant elements that themselves are [candidates for constraint validation](#) but do not [satisfy their constraints](#)

:invalid



:invalid

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 10+

Opera 10+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

The [:invalid pseudo-class](#) must match any element falling into one of the following categories:

- elements that are [candidates for constraint validation](#) but that do not [satisfy their constraints](#)
- [form](#) elements that are the [form owner](#) of one or more elements that themselves are [candidates for constraint validation](#) but do not [satisfy their constraints](#)
- [fieldset](#) elements that have of one or more descendant elements that themselves are [candidates for constraint validation](#) but do not [satisfy their constraints](#)

:in-range



:in-range

Support in all current engines.

Firefox 29+ Safari 5.1+ Chrome 10+

Opera 11+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 16+ Safari iOS 5+ Chrome Android 18+ WebView Android 2.2+ Samsung Internet 1.0+ Opera Android 11+

The [:in-range pseudo-class](#) must match all elements that are [candidates for constraint validation](#), [have range limitations](#), and that are neither [suffering from an underflow](#) nor [suffering from an overflow](#).

:out-of-range



:out-of-range

Support in all current engines.

Firefox 29+ Safari 5.1+ Chrome 10+

Opera 11+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 16+ Safari iOS 5+ Chrome Android 18+ WebView Android 2.2+ Samsung Internet 1.0+ Opera Android 11+

The [:out-of-range pseudo-class](#) must match all elements that are [candidates for constraint validation](#), [have range limitations](#), and that are either [suffering from an underflow](#) or [suffering from an overflow](#).

:required



:required

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 10+

Opera 10+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 4.4.3+ Samsung Internet 1.0+ Opera Android 10.1+

The [:required pseudo-class](#) must match any element falling into one of the following categories:

- [input](#) elements that are [required](#)
- [select](#) elements that have a [required](#) attribute
- [textarea](#) elements that have a [required](#) attribute

:optional



[:optional](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 10+

Opera 10+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+

The [:optional pseudo-class](#) must match any element falling into one of the following categories:

- [input](#) elements to which the [required](#) attribute applies that are not [required](#)
- [select](#) elements that do not have a [required](#) attribute
- [textarea](#) elements that do not have a [required](#) attribute

:autofill



[:autofill](#)

Support in all current engines.

Firefox 86+ Safari preview+ Chrome 96+

Opera 82+ Edge 96+

Edge (Legacy) No Internet Explorer No

Firefox Android 86+ Safari iOS 11+ Chrome Android 96+ WebView Android 96+ Samsung Internet 1.0+ Opera Android 14+

: -webkit-autofill

The [:autofill](#) and [:-webkit-autofill pseudo-classes](#) must match [input](#) elements which have been autofilled by user agent. These pseudo-classes must stop matching if the user edits the autofilled field.

One way such autofilling might happen is via the [autocomplete](#) attribute, but user agents could autofocus even without that attribute being involved.

:read-only



[:read-only](#)

Support in all current engines.

Firefox 78+ Safari 4+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

:read-write



[:read-write](#)

Support in all current engines.

Firefox 78+ Safari 4+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 13+ Internet Explorer No

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

The [:read-write pseudo-class](#) must match any element falling into one of the following categories, which for the purposes of Selectors are thus considered *user-alterable*:

[\[SELECTORS\]](#)

- [input](#) elements to which the [readonly](#) attribute applies, and that are [mutable](#) (i.e. that do not have the [readonly](#) attribute specified and that are not [disabled](#))
- [textarea](#) elements that do not have a [readonly](#) attribute, and that are not [disabled](#)
- elements that are [editing hosts](#) or [editable](#) and are neither [input](#) elements nor [textarea](#) elements

The [:read-only pseudo-class](#) must match all other [HTML elements](#).

:dir(ltr)



[:dir](#)

Support in one engine only.

Firefox 49+ Safari No Chrome No

OperaNoEdgeNo

Edge (Legacy)NoInternet ExplorerNo

Firefox Android49+Safari iOSNoChrome AndroidNoWebView AndroidNoSamsung
InternetNoOpera AndroidNo

The [:dir\(ltr\) pseudo-class](#) must match all elements whose [directionality](#) is 'ltr'.

:dir(rtl)

The [:dir\(rtl\) pseudo-class](#) must match all elements whose [directionality](#) is 'rtl'.

This specification does not define when an element matches the [:lang\(\)](#) dynamic [pseudo-class](#), as it is defined in sufficient detail in a language-agnostic fashion in [Selectors](#).

[\[SELECTORS\]](#)

5 Microdata

5.1 Introduction

5.1.1 Overview

This section is non-normative.

Sometimes, it is desirable to annotate content with specific machine-readable labels, e.g. to allow generic scripts to provide services that are customized to the page, or to enable content from a variety of cooperating authors to be processed by a single script in a consistent manner.

For this purpose, authors can use the microdata features described in this section. Microdata allows nested groups of name-value pairs to be added to documents, in parallel with the existing content.

5.1.2 The basic syntax

This section is non-normative.

At a high level, microdata consists of a group of name-value pairs. The groups are called [items](#), and each name-value pair is a property. Items and properties are represented by regular elements.

To create an item, the [itemscope](#) attribute is used.

To add a property to an item, the [itemprop](#) attribute is used on one of the [item's](#) descendants.

Here there are two items, each of which has the property "name":

```
<div itemscope>
```

```
<p>My name is <span itemprop="name">Elizabeth</span>.</p>
</div>

<div itemscope>
  <p>My name is <span itemprop="name">Daniel</span>.</p>
</div>
```

Markup without the microdata-related attributes does not have any effect on the microdata model.

These two examples are exactly equivalent, at a microdata level, as the previous two examples respectively:

```
<div itemscope>
  <p>My <em>name</em> is <span itemprop="name">E<strong>liz</strong>abeth</span>
</div>

<section>
  <div itemscope>
    <aside>
      <p>My name is <span itemprop="name"><a href="/?user=daniel">Daniel</a></span>
    </aside>
  </div>
</section>
```

Properties generally have values that are strings.

Here the item has three properties:

```
<div itemscope>
  <p>My name is <span itemprop="name">Neil</span>.</p>
  <p>My band is called <span itemprop="band">Four Parts Water</span>.</p>
  <p>I am <span itemprop="nationality">British</span>.</p>
</div>
```

When a string value is a [URL](#), it is expressed using the [a](#) element and its [href](#) attribute, the [img](#) element and its [src](#) attribute, or other elements that link to or embed external resources.

In this example, the item has one property, "image", whose value is a URL:

```
<div itemscope>
  
</div>
```

When a string value is in some machine-readable format unsuitable for human consumption, it is expressed using the [value](#) attribute of the [data](#) element, with the human-readable version given in the element's contents.

Here, there is an item with a property whose value is a product ID. The ID is not human-friendly, so the product's name is used the human-visible text instead of the ID.

```
<h1 itemscope>
  <data itemprop="product-id" value="9678A0U879">The Instigator 2000</data>
</h1>
```

For numeric data, the [meter](#) element and its [value](#) attribute can be used instead.

Here a rating is given using a [meter](#) element.

```
<div itemscope itemtype="http://schema.org/Product">
  <span itemprop="name">Panasonic White 60L Refrigerator</span>
  
  <div itemprop="aggregateRating"
    itemscope itemtype="http://schema.org/AggregateRating">
    <meter itemprop="ratingValue" min=0 value=3.5 max=5>Rated 3.5/5</meter>
    (based on <span itemprop="reviewCount">11</span> customer reviews)
  </div>
</div>
```

Similarly, for date- and time-related data, the [time](#) element and its [datetime](#) attribute can be used instead.

In this example, the item has one property, "birthday", whose value is a date:

```
<div itemscope>
  I was born on <time itemprop="birthday" datetime="2009-05-10">May 10th 2009</time>
</div>
```

Properties can also themselves be groups of name-value pairs, by putting the [itemscope](#) attribute on the element that declares the property.

Items that are not part of others are called [top-level microdata items](#).

In this example, the outer item represents a person, and the inner one represents a band:

```
<div itemscope>
  <p>Name: <span itemprop="name">Amanda</span></p>
  <p>Band: <span itemprop="band" itemscope> <span itemprop="name">Jazz Band</span>
</div>
```

The outer item here has two properties, "name" and "band". The "name" is "Amanda", and the "band" is an item in its own right, with two properties, "name" and "size". The "name" of the band is "Jazz Band", and the "size" is "12".

The outer item in this example is a top-level microdata item.

Properties that are not descendants of the element with the [itemscope](#) attribute can be associated with the [item](#) using the [itemref](#) attribute. This attribute takes a list of IDs of elements to crawl in addition to crawling the children of the element with the [itemscope](#) attribute.

This example is the same as the previous one, but all the properties are separated from their [items](#):

```
<div itemscope id="amanda" itemref="a b"></div>
<p id="a">Name: <span itemprop="name">Amanda</span></p>
<div id="b" itemprop="band" itemscope itemref="c"></div>
<div id="c">
  <p>Band: <span itemprop="name">Jazz Band</span></p>
  <p>Size: <span itemprop="size">12</span> players</p>
</div>
```

This gives the same result as the previous example. The first item has two properties, "name", set to "Amanda", and "band", set to another item. That second item has two further properties, "name", set to "Jazz Band", and "size", set to "12".

An [item](#) can have multiple properties with the same name and different values.

This example describes an ice cream, with two flavors:

```
<div itemscope>
  <p>Flavors in my favorite ice cream:</p>
  <ul>
    <li itemprop="flavor">Lemon sorbet</li>
    <li itemprop="flavor">Apricot sorbet</li>
  </ul>
</div>
```

This thus results in an item with two properties, both "flavor", having the values "Lemon sorbet" and "Apricot sorbet".

An element introducing a property can also introduce multiple properties at once, to avoid duplication when some of the properties have the same value.

Here we see an item with two properties, "favorite-color" and "favorite-fruit", both set to the value "orange":

```
<div itemscope>
  <span itemprop="favorite-color favorite-fruit">orange</span>
</div>
```

It's important to note that there is no relationship between the microdata and the content of the document where the microdata is marked up.

There is no semantic difference, for instance, between the following two examples:

```
<figure>
  
  <figcaption><span itemscope><span itemprop="name">The Castle</span></span> ( 
</figure>

<span itemscope><meta itemprop="name" content="The Castle"></span>
<figure>
  
  <figcaption>The Castle (1986)</figcaption>
</figure>
```

Both have a figure with a caption, and both, completely unrelated to the figure, have an item with a name-value pair with the name "name" and the value "The Castle". The only difference is that if the user drags the caption out of the document, in the former case, the item will be included in the drag-and-drop data. In neither case is the image in any way associated with the item.

5.1.3 Typed items

This section is non-normative.

The examples in the previous section show how information could be marked up on a page that doesn't expect its microdata to be re-used. Microdata is most useful, though, when it is used in contexts where other authors and readers are able to cooperate to make new uses of the markup.

For this purpose, it is necessary to give each [item](#) a type, such as "<https://example.com/person>", or "<https://example.org/cat>", or "<https://band.example.net/>". Types are identified as [URLs](#).

The type for an [item](#) is given as the value of an [itemtype](#) attribute on the same element as the [itemscope](#) attribute.

Here, the item's type is "<https://example.org/animals#cat>":

```
<section itemscope itemtype="https://example.org/animals#cat">
  <h1 itemprop="name">Hedral</h1>
  <p itemprop="desc">Hedral is a male american domestic
  shorthair, with a fluffy black fur with white paws and belly.</p>
  
</section>
```

In this example the "<https://example.org/animals#cat>" item has three properties, a "name" ("Hedral"), a "desc" ("Hedral is..."), and an "img" ("hedral.jpeg").

The type gives the context for the properties, thus selecting a vocabulary: a property named

"class" given for an item with the type "https://census.example/person" might refer to the economic class of an individual, while a property named "class" given for an item with the type "https://example.com/school/teacher" might refer to the classroom a teacher has been assigned. Several types can share a vocabulary. For example, the types "<https://example.org/people/teacher>" and "<https://example.org/people/engineer>" could be defined to use the same vocabulary (though maybe some properties would not be especially useful in both cases, e.g. maybe the "<https://example.org/people/engineer>" type might not typically be used with the "classroom" property). Multiple types defined to use the same vocabulary can be given for a single item by listing the URLs as a space-separated list in the attribute' value. An item cannot be given two types if they do not use the same vocabulary, however.

5.1.4 Global identifiers for items

This section is non-normative.

Sometimes, an [item](#) gives information about a topic that has a global identifier. For example, books can be identified by their ISBN number.

Vocabularies (as identified by the [itemtype](#) attribute) can be designed such that [items](#) get associated with their global identifier in an unambiguous way by expressing the global identifiers as [URLs](#) given in an [itemid](#) attribute.

The exact meaning of the [URLs](#) given in [itemid](#) attributes depends on the vocabulary used.

Here, an item is talking about a particular book:

```
<dl itemscope
    itemtype="https://vocab.example.net/book"
    itemid="urn:isbn:0-330-34032-8">
    <dt>Title
    <dd itemprop="title">The Reality Dysfunction
    <dt>Author
    <dd itemprop="author">Peter F. Hamilton
    <dt>Publication date
    <dd><time itemprop="pubdate" datetime="1996-01-26">26 January 1996</time>
</dl>
```

The "https://vocab.example.net/book" vocabulary in this example would define that the [itemid](#) attribute takes a [urn: URL](#) pointing to the ISBN of the book.

5.1.5 Selecting names when defining vocabularies

This section is non-normative.

Using microdata means using a vocabulary. For some purposes, an ad-hoc vocabulary is adequate. For others, a vocabulary will need to be designed. Where possible, authors are

encouraged to re-use existing vocabularies, as this makes content re-use easier.

When designing new vocabularies, identifiers can be created either using [URLs](#), or, for properties, as plain words (with no dots or colons). For URLs, conflicts with other vocabularies can be avoided by only using identifiers that correspond to pages that the author has control over.

For instance, if Jon and Adam both write content at `example.com`, at `https://example.com/~jon/...` and `https://example.com/~adam/...` respectively, then they could select identifiers of the form "`https://example.com/~jon/name`" and "`https://example.com/~adam/name`" respectively.

Properties whose names are just plain words can only be used within the context of the types for which they are intended; properties named using URLs can be reused in items of any type. If an item has no type, and is not part of another item, then if its properties have names that are just plain words, they are not intended to be globally unique, and are instead only intended for limited use. Generally speaking, authors are encouraged to use either properties with globally unique names (URLs) or ensure that their items are typed.

Here, an item is an "`https://example.org/animals#cat`", and most of the properties have names that are words defined in the context of that type. There are also a few additional properties whose names come from other vocabularies.

```
<section itemscope itemtype="https://example.org/animals#cat">
  <h1 itemprop="name https://example.com/fn">Hedral</h1>
  <p itemprop="desc">Hedral is a male American domestic
  shorthair, with a fluffy <span
  itemprop="https://example.com/color">black</span> fur with <span
  itemprop="https://example.com/color">white</span> paws and belly.</p>
  
</section>
```

This example has one item with the type "`https://example.org/animals#cat`" and the following properties:

Property	Value
name	Hedral
https://example.com/fn	Hedral
desc	Hedral is a male American domestic shorthair, with a fluffy black fur with white paws and belly.
https://example.com/color	black
https://example.com/color	white
img	.../hederal.jpeg

5.2 Encoding microdata

5.2.1 The microdata model

The microdata model consists of groups of name-value pairs known as [items](#).

Each group is known as an [item](#). Each [item](#) can have [item types](#), a [global identifier](#) (if the vocabulary specified by the [item types support global identifiers for items](#)), and a list of name-value pairs. Each name in the name-value pair is known as a [property](#), and each [property](#) has one or more [values](#). Each [value](#) is either a string or itself a group of name-value pairs (an [item](#)). The names are unordered relative to each other, but if a particular name has multiple values, they do have a relative order.

5.2.2 Items



[Global_attributes/itemscope](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Every [HTML element](#) may have an [*itemscope*](#) attribute specified. The [*itemscope*](#) attribute is a [boolean attribute](#).

An element with the [*itemscope*](#) attribute specified creates a new *item*, a group of name-value pairs.



[Global_attributes/itemtype](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Elements with an [itemscope](#) attribute may have an [itemtype](#) attribute specified, to give the [item types](#) of the [item](#).

The [itemtype](#) attribute, if specified, must have a value that is an [unordered set of unique space-separated tokens](#), none of which are [identical](#) to another token and each of which is a [valid URL string](#) that is an [absolute URL](#), and all of which are defined to use the same vocabulary. The attribute's value must have at least one token.

The [item types](#) of an [item](#) are the tokens obtained by [splitting the element's itemtype attribute's value on ASCII whitespace](#). If the [itemtype](#) attribute is missing or parsing it in this way finds no tokens, the [item](#) is said to have no [item types](#).

The [item types](#) must all be types defined in [applicable specifications](#) and must all be defined to use the same vocabulary.

Except if otherwise specified by that specification, the [URLs](#) given as the [item types](#) should not be automatically dereferenced.

A specification could define that its [item type](#) can be dereferenced to provide the user with help information, for example. In fact, vocabulary authors are encouraged to provide useful information at the given [URL](#).

[Item types](#) are opaque identifiers, and user agents must not dereference unknown [item types](#), or otherwise deconstruct them, in order to determine how to process [items](#) that use them.

The [itemtype](#) attribute must not be specified on elements that do not have an [itemscope](#) attribute specified.

An [item](#) is said to be a *typed item* when either it has an [item type](#), or it is the [value](#) of a [property](#) of a [typed item](#). The *relevant types* for a [typed item](#) is the [item](#)'s [item types](#), if it has any, or else is the [relevant types](#) of the [item](#) for which it is a [property](#)'s [value](#).



[Global_attributes/itemid](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Elements with an [itemscope](#) attribute and an [itemtype](#) attribute that references a

vocabulary that is defined to *support global identifiers for items* may also have an **`itemid`** attribute specified, to give a global identifier for the **`item`**, so that it can be related to other **`items`** on pages elsewhere on the web.

The **`itemid`** attribute, if specified, must have a value that is a [valid URL potentially surrounded by spaces](#).

The *global identifier* of an **`item`** is the value of its element's **`itemid`** attribute, if it has one, [parsed relative to the node document](#) of the element on which the attribute is specified. If the **`itemid`** attribute is missing or if resolving it fails, it is said to have no [global identifier](#).

The **`itemid`** attribute must not be specified on elements that do not have both an **`itemscope`** attribute and an **`itemtype`** attribute specified, and must not be specified on elements with an **`itemscope`** attribute whose **`itemtype`** attribute specifies a vocabulary that does not [support global identifiers for items](#), as defined by that vocabulary's specification.

The exact meaning of a [global identifier](#) is determined by the vocabulary's specification. It is up to such specifications to define whether multiple items with the same global identifier (whether on the same page or on different pages) are allowed to exist, and what the processing rules for that vocabulary are with respect to handling the case of multiple items with the same ID.



[Global_attributes/itemref](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Elements with an **`itemscope`** attribute may have an **`itemref`** attribute specified, to give a list of additional elements to crawl to find the name-value pairs of the **`item`**.

The **`itemref`** attribute, if specified, must have a value that is an [unordered set of unique space-separated tokens](#) none of which are [identical to](#) another token and consisting of [IDs](#) of elements in the same [tree](#).

The **`itemref`** attribute must not be specified on elements that do not have an **`itemscope`** attribute specified.

The **`itemref`** attribute is not part of the microdata data model. It is merely a syntactic construct to aid authors in adding annotations to pages where the data to be annotated does not follow a convenient tree structure. For example, it allows authors to mark up data in a

table so that each column defines a separate [item](#), while keeping the properties in the cells.

This example shows a simple vocabulary used to describe the products of a model railway manufacturer. The vocabulary has just five property names:

product-code

An integer that names the product in the manufacturer's catalog.

name

A brief description of the product.

scale

One of "HO", "1", or "Z" (potentially with leading or trailing whitespace), indicating the scale of the product.

digital

If present, one of "Digital", "Delta", or "Systems" (potentially with leading or trailing whitespace) indicating that the product has a digital decoder of the given type.

track-type

For track-specific products, one of "K", "M", "C" (potentially with leading or trailing whitespace) indicating the type of track for which the product is intended.

This vocabulary has four defined [item types](#):

<https://md.example.com/loco>

Rolling stock with an engine

<https://md.example.com/passengers>

Passenger rolling stock

<https://md.example.com/track>

Track pieces

<https://md.example.com/lighting>

Equipment with lighting

Each [item](#) that uses this vocabulary can be given one or more of these types, depending on what the product is.

Thus, a locomotive might be marked up as:

```
<dl itemscope itemtype="https://md.example.com/loco
          https://md.example.com/lighting">
  <dt>Name:
  <dd itemprop="name">Tank Locomotive (DB 80)
  <dt>Product code:
  <dd itemprop="product-code">33041
  <dt>Scale:
```

```
<dd itemprop="scale">H0
<dt>Digital:
<dd itemprop="digital">Delta
</dl>
```

A turnout lantern retrofit kit might be marked up as:

```
<dl itemscope itemtype="https://md.example.com/track
https://md.example.com/lighting">
<dt>Name:
<dd itemprop="name">Turnout Lantern Kit
<dt>Product code:
<dd itemprop="product-code">74470
<dt>Purpose:
<dd>For retrofitting 2 <span itemprop="track-type">C</span> Track
turnouts. <meta itemprop="scale" content="H0">
</dl>
```

A passenger car with no lighting might be marked up as:

```
<dl itemscope itemtype="https://md.example.com/passengers">
<dt>Name:
<dd itemprop="name">Express Train Passenger Car (DB Am 203)
<dt>Product code:
<dd itemprop="product-code">8710
<dt>Scale:
<dd itemprop="scale">Z
</dl>
```

Great care is necessary when creating new vocabularies. Often, a hierarchical approach to types can be taken that results in a vocabulary where each item only ever has a single type, which is generally much simpler to manage.

5.2.3 Names: the **itemprop** attribute



[Global_attributes/itemprop](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy) 12+ Internet Explorer Yes

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

Every [HTML element](#) may have an [`itemprop`](#) attribute specified, if doing so [adds one or more properties](#) to one or more [`items`](#) (as defined below).

The [`itemprop`](#) attribute, if specified, must have a value that is an [unordered set of unique space-separated tokens](#) none of which are [identical to](#) another token, representing the names of the name-value pairs that it adds. The attribute's value must have at least one token.

Each token must be either:

- If the item is a [`typed item`](#): a *defined property name* allowed in this situation according to the specification that defines the [relevant types](#) for the item, or
- A [`valid URL string`](#) that is an [`absolute URL`](#) defined as an item property name allowed in this situation by a vocabulary specification, or
- A [`valid URL string`](#) that is an [`absolute URL`](#), used as a proprietary item property name (i.e. one used by the author for private purposes, not defined in a public specification), or
- If the item is not a [`typed item`](#): a string that contains no U+002E FULL STOP characters (.) and no U+003A COLON characters (:), used as a proprietary item property name (i.e. one used by the author for private purposes, not defined in a public specification).

Specifications that introduce [defined property names](#) must ensure all such property names contain no U+002E FULL STOP characters (.), no U+003A COLON characters (:), and no [ASCII whitespace](#).

The rules above disallow U+003A COLON characters (:) in non-URL values because otherwise they could not be distinguished from URLs. Values with U+002E FULL STOP characters (.) are reserved for future extensions. [ASCII whitespace](#) are disallowed because otherwise the values would be parsed as multiple tokens.

When an element with an [`itemprop`](#) attribute [adds a property](#) to multiple [`items`](#), the requirement above regarding the tokens applies for each [`item`](#) individually.

The *property names* of an element are the tokens that the element's [`itemprop`](#) attribute is found to contain when its value is [split on ASCII whitespace](#), with the order preserved but with duplicates removed (leaving only the first occurrence of each name).

Within an [`item`](#), the properties are unordered with respect to each other, except for properties with the same name, which are ordered in the order they are given by the algorithm that defines [the properties of an item](#).

In the following example, the "a" property has the values "1" and "2", *in that order*, but whether the "a" property comes before the "b" property or not is not important:

```
<div itemscope>
  <p itemprop="a">1</p>
  <p itemprop="a">2</p>
  <p itemprop="b">test</p>
</div>
```

Thus, the following is equivalent:

```
<div itemscope>
  <p itemprop="b">test</p>
  <p itemprop="a">1</p>
  <p itemprop="a">2</p>
</div>
```

As is the following:

```
<div itemscope>
  <p itemprop="a">1</p>
  <p itemprop="b">test</p>
  <p itemprop="a">2</p>
</div>
```

And the following:

```
<div id="x">
  <p itemprop="a">1</p>
</div>
<div itemscope itemref="x">
  <p itemprop="b">test</p>
  <p itemprop="a">2</p>
</div>
```

5.2.4 Values

The *property value* of a name-value pair added by an element with an [itemprop](#) attribute is as given for the first matching case in the following list:

If the element also has an [itemscope](#) attribute

The value is the [item](#) created by the element.

If the element is a [meta](#) element

The value is the value of the element's [content](#) attribute, if any, or the empty string if there is no such attribute.

If the element is an [audio](#), [embed](#), [iframe](#), [img](#), [source](#), [track](#), or [video](#) element

The value is the [resulting URL string](#) that results from [parsing](#) the value of the element's [src](#) attribute relative to the [node document](#) of the element at the time the attribute is set, or the empty string if there is no such attribute or if [parsing](#) it results in an error.

If the element is an [a](#), [area](#), or [link](#) element

The value is the [resulting URL string](#) that results from [parsing](#) the value of the element's `href` attribute relative to the [node document](#) of the element at the time the attribute is set, or the empty string if there is no such attribute or if [parsing](#) it results in an error.

If the element is an [object](#) element

The value is the [resulting URL string](#) that results from [parsing](#) the value of the element's `data` attribute relative to the [node document](#) of the element at the time the attribute is set, or the empty string if there is no such attribute or if [parsing](#) it results in an error.

If the element is a [data](#) element

The value is the value of the element's `value` attribute, if it has one, or the empty string otherwise.

If the element is a [meter](#) element

The value is the value of the element's `value` attribute, if it has one, or the empty string otherwise.

If the element is a [time](#) element

The value is the element's [datetime value](#).

Otherwise

The value is the element's [descendant text content](#).

The *URL property elements* are the [a](#), [area](#), [audio](#), [embed](#), [iframe](#), [img](#), [link](#), [object](#), [source](#), [track](#), and [video](#) elements.

If a property's `value`, as defined by the property's definition, is an [absolute URL](#), the property must be specified using a [URL property element](#).

These requirements do not apply just because a property value happens to match the syntax for a URL. They only apply if the property is explicitly defined as taking such a value.

For example, a book about the first moon landing could be called "mission:moon". A "title" property from a vocabulary that defines a title as being a string would not expect the title to be given in an [a](#) element, even though it looks like a [URL](#). On the other hand, if there was a (rather narrowly scoped!) vocabulary for "books whose titles look like URLs" which had a "title" property defined to take a URL, then the property *would* expect the title to be given in an [a](#) element (or one of the other [URL property elements](#)), because of the requirement above.

5.2.5 Associating names with items

To find *the properties of an item* defined by the element *root*, the user agent must run the following steps. These steps are also used to flag [microdata errors](#).

1. Let *results*, *memory*, and *pending* be empty lists of elements.
2. Add the element *root* to *memory*.
3. Add the child elements of *root*, if any, to *pending*.
4. If *root* has an [**itemref**](#) attribute, [split the value of that **itemref** attribute on ASCII whitespace](#). For each resulting token *ID*, if there is an element in the [tree](#) of *root* with the [ID *ID*](#), then add the first such element to *pending*.
5. While *pending* is not empty:
 1. Remove an element from *pending* and let *current* be that element.
 2. If *current* is already in *memory*, there is a [microdata error](#); [continue](#).
 3. Add *current* to *memory*.
 4. If *current* does not have an [**itemscope**](#) attribute, then: add all the child elements of *current* to *pending*.
 5. If *current* has an [**itemprop**](#) attribute specified and has one or more [property names](#), then add *current* to *results*.
6. Sort *results* in [tree order](#).
7. Return *results*.

A document must not contain any [items](#) for which the algorithm to find [the properties of an item](#) finds any [microdata errors](#).

An [item](#) is a *top-level microdata item* if its element does not have an [**itemprop**](#) attribute.

All [**itemref**](#) attributes in a [**Document**](#) must be such that there are no cycles in the graph formed from representing each [item](#) in the [**Document**](#) as a node in the graph and each [property](#) of an item whose [value](#) is another item as an edge in the graph connecting those two items.

A document must not contain any elements that have an [**itemprop**](#) attribute that would not be found to be a property of any of the [items](#) in that document were their [properties](#) all to be determined.

In this example, a single license statement is applied to two works, using [**itemref**](#) from the items representing the works:

```
<!DOCTYPE HTML>
<html lang="en">
<head>
  <title>Photo gallery</title>
</head>
<body>
  <h1>My photos</h1>
  <figure itemscope itemtype="http://n.whatwg.org/work" itemref="licenses">
    
    <figcaption itemprop="title">The house I found.</figcaption>
  </figure>
  <figure itemscope itemtype="http://n.whatwg.org/work" itemref="licenses">
    
    <figcaption itemprop="title">The mailbox.</figcaption>
  </figure>
  <footer>
    <p id="licenses">All images licensed under the <a itemprop="license" href="http://www.opensource.org/licenses/mit-license.php">MIT license</a>.</p>
  </footer>
</body>
</html>
```

The above results in two items with the type "`http://n.whatwg.org/work`", one with:

work

`images/house.jpeg`

title

 The house I found.

license

`http://www.opensource.org/licenses/mit-license.php`

...and one with:

work

`images/mailbox.jpeg`

title

 The mailbox.

license

`http://www.opensource.org/licenses/mit-license.php`

5.2.6 Microdata and other namespaces

Currently, the [itemscope](#), [itemprop](#), and other microdata attributes are only defined for [HTML elements](#). This means that attributes with the literal names "itemscope", "itemprop", etc, do not cause microdata processing to occur on elements in other namespaces, such as SVG.

Thus, in the following example there is only one item, not two.

```
<p itemscope></p> <!-- this is an item (with no properties and no type) -->
<svg itemscope></svg> <!-- this is not, it's just an SVG svg element with an
```

5.3 Sample microdata vocabularies

The vocabularies in this section are primarily intended to demonstrate how a vocabulary is specified, though they are also usable in their own right.

5.3.1 vCard

An item with the [item type](#) <http://microformats.org/profile/hcard> represents a person's or organization's contact information.

This vocabulary does not [support global identifiers for items](#).

The following are the type's [defined property names](#). They are based on the vocabulary defined in *vCard Format Specification* (vCard) and its extensions, where more information on how to interpret the values can be found. [\[RFC6350\]](#)

kind

Describes what kind of contact the item represents.

The [value](#) must be text that is [identical to](#) one of the [kind strings](#).

A single property with the name [kind](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

fn

Gives the formatted text corresponding to the name of the person or organization.

The [value](#) must be text.

Exactly one property with the name [fn](#) must be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

n

Gives the structured name of the person or organization.

The [value](#) must be an [item](#) with zero or more of each of the [family-name](#), [given-name](#), [additional-name](#), [honorific-prefix](#), and [honorific-suffix](#) properties.

Exactly one property with the name [n](#) must be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

family-name (inside [n](#))

Gives the family name of the person, or the full name of the organization.

The [value](#) must be text.

Any number of properties with the name [family-name](#) may be present within the [item](#) that forms the [value](#) of the [n](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

given-name (inside [n](#))

Gives the given-name of the person.

The [value](#) must be text.

Any number of properties with the name [given-name](#) may be present within the [item](#) that forms the [value](#) of the [n](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

additional-name (inside [n](#))

Gives the any additional names of the person.

The [value](#) must be text.

Any number of properties with the name [additional-name](#) may be present within the [item](#) that forms the [value](#) of the [n](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

honorific-prefix (inside [n](#))

Gives the honorific prefix of the person.

The [value](#) must be text.

Any number of properties with the name [honorific-prefix](#) may be present within the

[item](#) that forms the [value](#) of the [n](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

honorific-suffix (inside [n](#))

Gives the honorific suffix of the person.

The [value](#) must be text.

Any number of properties with the name [honorific-suffix](#) may be present within the [item](#) that forms the [value](#) of the [n](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

nickname

Gives the nickname of the person or organization.

The nickname is the descriptive name given instead of or in addition to the one belonging to a person, place, or thing. It can also be used to specify a familiar form of a proper name specified by the [fn](#) or [n](#) properties.

The [value](#) must be text.

Any number of properties with the name [nickname](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

photo

Gives a photograph of the person or organization.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name [photo](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

bday

Gives the birth date of the person or organization.

The [value](#) must be a [valid date string](#).

A single property with the name [bday](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

anniversary

Gives the birth date of the person or organization.

The [value](#) must be a [valid date string](#).

A single property with the name [anniversary](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

sex

Gives the biological sex of the person.

The [value](#) must be one of **F**, meaning "female", **M**, meaning "male", **N**, meaning "none or not applicable", **O**, meaning "other", or **U**, meaning "unknown".

A single property with the name [sex](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

gender-identity

Gives the gender identity of the person.

The [value](#) must be text.

A single property with the name [gender-identity](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

adr

Gives the delivery address of the person or organization.

The [value](#) must be an [item](#) with zero or more [type](#), [post-office-box](#), [extended-address](#), and [street-address](#) properties, and optionally a [locality](#) property, optionally a [region](#) property, optionally a [postal-code](#) property, and optionally a [country-name](#) property.

If no [type](#) properties are present within an [item](#) that forms the [value](#) of an [adr](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>, then the address type string [work](#) is implied.

Any number of properties with the name [adr](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

type (inside [adr](#))

Gives the type of delivery address.

The [value](#) must be text that is [identical to](#) one of the [address type strings](#).

Any number of properties with the name [type](#) may be present within the [item](#) that forms

the value of an adr property of an item with the type <http://microformats.org/profile/hcard>, but within each such adr property item there must only be one type property per distinct value.

post-office-box (inside adr)

Gives the post office box component of the delivery address of the person or organization.

The value must be text.

Any number of properties with the name ***post-office-box*** may be present within the item that forms the value of an adr property of an item with the type <http://microformats.org/profile/hcard>.

vCard urges authors not to use this field.

extended-address (inside adr)

Gives an additional component of the delivery address of the person or organization.

The value must be text.

Any number of properties with the name ***extended-address*** may be present within the item that forms the value of an adr property of an item with the type <http://microformats.org/profile/hcard>.

vCard urges authors not to use this field.

street-address (inside adr)

Gives the street address component of the delivery address of the person or organization.

The value must be text.

Any number of properties with the name ***street-address*** may be present within the item that forms the value of an adr property of an item with the type <http://microformats.org/profile/hcard>.

locality (inside adr)

Gives the locality component (e.g. city) of the delivery address of the person or organization.

The value must be text.

A single property with the name ***locality*** may be present within the item that forms the value of an adr property of an item with the type <http://microformats.org/>

[profile/hcard](#).

region (inside [adr](#))

Gives the region component (e.g. state or province) of the delivery address of the person or organization.

The [value](#) must be text.

A single property with the name [region](#) may be present within the [item](#) that forms the [value](#) of an [adr](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

postal-code (inside [adr](#))

Gives the postal code component of the delivery address of the person or organization.

The [value](#) must be text.

A single property with the name [postal-code](#) may be present within the [item](#) that forms the [value](#) of an [adr](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

country-name (inside [adr](#))

Gives the country name component of the delivery address of the person or organization.

The [value](#) must be text.

A single property with the name [country-name](#) may be present within the [item](#) that forms the [value](#) of an [adr](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

tel

Gives the telephone number of the person or organization.

The [value](#) must be either text that can be interpreted as a telephone number as defined in the CCITT specifications E.163 and X.121, or an [item](#) with zero or more [type](#) properties and exactly one [value](#) property. [\[E163\]](#) [\[X121\]](#)

If no [type](#) properties are present within an [item](#) that forms the [value](#) of a [tel](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>, or if the [value](#) of such a [tel](#) property is text, then the [telephone type string voice](#) is implied.

Any number of properties with the name [tel](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

type (inside [tel](#))

Gives the type of telephone number.

The [value](#) must be text that is [identical to](#) one of the [telephone type strings](#).

Any number of properties with the name [type](#) may be present within the [item](#) that forms the [value](#) of a [tel](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>, but within each such [tel](#) property [item](#) there must only be one [type](#) property per distinct value.

value (inside [tel](#))

Gives the actual telephone number of the person or organization.

The [value](#) must be text that can be interpreted as a telephone number as defined in the CCITT specifications E.163 and X.121. [\[E163\]](#) [\[X121\]](#)

Exactly one property with the name [value](#) must be present within the [item](#) that forms the [value](#) of a [tel](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

email

Gives the email address of the person or organization.

The [value](#) must be text.

Any number of properties with the name [email](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

impp

Gives a [URL](#) for instant messaging and presence protocol communications with the person or organization.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name [impp](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

lang

Gives a language understood by the person or organization.

The [value](#) must be a valid BCP 47 language tag. [\[BCP47\]](#).

Any number of properties with the name [lang](#) may be present within each [item](#) with the

type <http://microformats.org/profile/hcard>.

tz

Gives the time zone of the person or organization.

The [value](#) must be text and must match the following syntax:

1. Either a U+002B PLUS SIGN character (+) or a U+002D HYPHEN-MINUS character (-).
2. A [valid non-negative integer](#) that is exactly two digits long and that represents a number in the range 00..23.
3. A U+003A COLON character (:).
4. A [valid non-negative integer](#) that is exactly two digits long and that represents a number in the range 00..59.

Any number of properties with the name [tz](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

geo

Gives the geographical position of the person or organization.

The [value](#) must be text and must match the following syntax:

1. Optionally, either a U+002B PLUS SIGN character (+) or a U+002D HYPHEN-MINUS character (-).
2. One or more [ASCII digits](#).
3. Optionally*, a U+002E FULL STOP character (.) followed by one or more [ASCII digits](#).
4. A U+003B SEMICOLON character (;).
5. Optionally, either a U+002B PLUS SIGN character (+) or a U+002D HYPHEN-MINUS character (-).
6. One or more [ASCII digits](#).
7. Optionally*, a U+002E FULL STOP character (.) followed by one or more [ASCII digits](#).

The optional components marked with an asterisk (*) should be included, and should have six digits each.

The value specifies latitude and longitude, in that order (i.e., "LAT LON" ordering), in decimal degrees. The longitude represents the location east and west of the prime meridian as a positive or negative real number, respectively. The latitude represents the location north and south of the equator as a positive or negative real number, respectively.

Any number of properties with the name [geo](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

title

Gives the job title, functional position or function of the person or organization.

The [value](#) must be text.

Any number of properties with the name [title](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

role

Gives the role, occupation, or business category of the person or organization.

The [value](#) must be text.

Any number of properties with the name [role](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

logo

Gives the logo of the person or organization.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name [logo](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

agent

Gives the contact information of another person who will act on behalf of the person or organization.

The [value](#) must be either an [item](#) with the type <http://microformats.org/profile/hcard>, or an [absolute URL](#), or text.

Any number of properties with the name [agent](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

org

Gives the name and units of the organization.

The [value](#) must be either text or an [item](#) with one [organization-name](#) property and zero or more [organization-unit](#) properties.

Any number of properties with the name [org](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

organization-name (inside [org](#))

Gives the name of the organization.

The [value](#) must be text.

Exactly one property with the name [organization-name](#) must be present within the [item](#) that forms the [value](#) of an [org](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

organization-unit (inside [org](#))

Gives the name of the organization unit.

The [value](#) must be text.

Any number of properties with the name [organization-unit](#) may be present within the [item](#) that forms the [value](#) of the [org](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

member

Gives a [URL](#) that represents a member of the group.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name [member](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard> if the [item](#) also has a property with the name [kind](#) whose value is "[group](#)".

related

Gives a relationship to another entity.

The [value](#) must be an [item](#) with one [url](#) property and one [rel](#) properties.

Any number of properties with the name [related](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

url (inside [related](#))

Gives the [URL](#) for the related entity.

The [value](#) must be an [absolute URL](#).

Exactly one property with the name [url](#) must be present within the [item](#) that forms the [value](#) of a [related](#) property of an [item](#) with the type <http://microformats.org/>

[profile/hcard](#).

rel (inside [related](#))

Gives the relationship between the entity and the related entity.

The [value](#) must be text that is [identical to](#) one of the [relationship strings](#).

Exactly one property with the name [rel](#) must be present within the [item](#) that forms the [value](#) of a [related](#) property of an [item](#) with the type <http://microformats.org/profile/hcard>.

categories

Gives the name of a category or tag that the person or organization could be classified as.

The [value](#) must be text.

Any number of properties with the name [categories](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

note

Gives supplemental information or a comment about the person or organization.

The [value](#) must be text.

Any number of properties with the name [note](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

rev

Gives the revision date and time of the contact information.

The [value](#) must be text that is a [valid global date and time string](#).

The value distinguishes the current revision of the information for other renditions of the information.

Any number of properties with the name [rev](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

sound

Gives a sound file relating to the person or organization.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name [sound](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

uid

Gives a globally unique identifier corresponding to the person or organization.

The [value](#) must be text.

A single property with the name [uid](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

url

Gives a [URL](#) relating to the person or organization.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name [url](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcard>.

The *kind strings* are:

individual

Indicates a single entity (e.g. a person).

group

Indicates multiple entities (e.g. a mailing list).

org

Indicates a single entity that is not a person (e.g. a company).

location

Indicates a geographical place (e.g. an office building).

The *address type strings* are:

home

Indicates a delivery address for a residence.

work

Indicates a delivery address for a place of work.

The *telephone type strings* are:

home

Indicates a residential number.

work

Indicates a telephone number for a place of work.

text

Indicates that the telephone number supports text messages (SMS).

voice

Indicates a voice telephone number.

fax

Indicates a facsimile telephone number.

cell

Indicates a cellular telephone number.

video

Indicates a video conferencing telephone number.

pager

Indicates a paging device telephone number.

textphone

Indicates a telecommunication device for people with hearing or speech difficulties.

The *relationship strings* are:

emergency

An emergency contact.

agent

Another entity that acts on behalf of this entity.

contact
acquaintance
friend
met
worker
colleague
resident
neighbor
child
parent
sibling
spouse
kin
muse
crush
date
sweetheart
me

Has the meaning defined in XFN. [\[XFN\]](#)

5.3.1.1 Conversion to vCard

Given a list of nodes *nodes* in a [Document](#), a user agent must run the following algorithm to extract any vCard data represented by those *nodes* (only the first vCard is returned):

1. If none of the nodes in *nodes* are [items](#) with the [item type](#) <http://microformats.org/profile/hcard>, then there is no vCard. Abort the algorithm, returning nothing.
2. Let *node* be the first node in *nodes* that is an [item](#) with the [item type](#) <http://microformats.org/profile/hcard>.
3. Let *output* be an empty string.
4. [Add a vCard line](#) with the type "BEGIN" and the value "VCARD" to *output*.
5. [Add a vCard line](#) with the type "PROFILE" and the value "VCARD" to *output*.
6. [Add a vCard line](#) with the type "VERSION" and the value "4.0" to *output*.
7. [Add a vCard line](#) with the type "SOURCE" and the result of [escaping the vCard text string](#) that is the document's [URL](#) as the value to *output*.
8. If [the title element](#) is not null, [add a vCard line](#) with the type "NAME" and with the result of [escaping the vCard text string](#) obtained from [the title element's descendant text content](#) as the value to *output*.

9. Let *sex* be the empty string.
10. Let *gender-identity* be the empty string.
11. For each element *element* that is [a property of the item node](#): for each name *name* in *element's property names*, run the following substeps:
 1. Let *parameters* be an empty set of name-value pairs.
 2. Run the appropriate set of substeps from the following list. The steps will set a variable *value*, which is used in the next step.

If the property's [value](#) is an [item subitem](#) and *name* is [n](#)

1. Let *value* be the empty string.
2. Append to *value* the result of [collecting the first vCard subproperty named \[family-name\]\(#\) in subitem](#).
3. Append a U+003B SEMICOLON character (;) to *value*.
4. Append to *value* the result of [collecting the first vCard subproperty named \[given-name\]\(#\) in subitem](#).
5. Append a U+003B SEMICOLON character (;) to *value*.
6. Append to *value* the result of [collecting the first vCard subproperty named \[additional-name\]\(#\) in subitem](#).
7. Append a U+003B SEMICOLON character (;) to *value*.
8. Append to *value* the result of [collecting the first vCard subproperty named \[honorific-prefix\]\(#\) in subitem](#).
9. Append a U+003B SEMICOLON character (;) to *value*.
10. Append to *value* the result of [collecting the first vCard subproperty named \[honorific-suffix\]\(#\) in subitem](#).

If the property's [value](#) is an [item subitem](#) and *name* is [adr](#)

1. Let *value* be the empty string.
2. Append to *value* the result of [collecting vCard subproperties named \[post-office-box\]\(#\) in subitem](#).
3. Append a U+003B SEMICOLON character (;) to *value*.

4. Append to *value* the result of [collecting vCard subproperties](#) named [extended-address](#) in *subitem*.
5. Append a U+003B SEMICOLON character (;) to *value*.
6. Append to *value* the result of [collecting vCard subproperties](#) named [street-address](#) in *subitem*.
7. Append a U+003B SEMICOLON character (;) to *value*.
8. Append to *value* the result of [collecting the first vCard subproperty](#) named [locality](#) in *subitem*.
9. Append a U+003B SEMICOLON character (;) to *value*.
10. Append to *value* the result of [collecting the first vCard subproperty](#) named [region](#) in *subitem*.
11. Append a U+003B SEMICOLON character (;) to *value*.
12. Append to *value* the result of [collecting the first vCard subproperty](#) named [postal-code](#) in *subitem*.
13. Append a U+003B SEMICOLON character (;) to *value*.
14. Append to *value* the result of [collecting the first vCard subproperty](#) named [country-name](#) in *subitem*.
15. If there is a property named [type](#) in *subitem*, and the first such property has a [value](#) that is not an [item](#) and whose value consists only of [ASCII alphanumerics](#), then add a parameter named "TYPE" whose value is the [value](#) of that property to *parameters*.

If the property's [value](#) is an [item](#) *subitem* and *name* is [org](#)

1. Let *value* be the empty string.
2. Append to *value* the result of [collecting the first vCard subproperty](#) named [organization-name](#) in *subitem*.
3. For each property named [organization-unit](#) in *subitem*, run the following steps:
 1. If the [value](#) of the property is an [item](#), then skip this property.
 2. Append a U+003B SEMICOLON character (;) to *value*.

3. Append the result of [escaping the vCard text string](#) given by the [value](#) of the property to *value*.

If the property's [value](#) is an [item](#) *subitem* with the [item type](#) <http://microformats.org/profile/hcard> and *name* is [related](#)

1. Let *value* be the empty string.
2. If there is a property named [url](#) in *subitem*, and its element is a [URL property element](#), then append the result of [escaping the vCard text string](#) given by the [value](#) of the first such property to *value*, and add a parameter with the name "VALUE" and the value "URI" to *parameters*.
3. If there is a property named [rel](#) in *subitem*, and the first such property has a [value](#) that is not an [item](#) and whose value consists only of [ASCII alphanumericics](#), then add a parameter named "RELATION" whose value is the [value](#) of that property to *parameters*.

If the property's [value](#) is an [item](#) and *name* is none of the above

1. Let *value* be the result of [collecting the first vCard subproperty](#) named **value** in *subitem*.
2. If there is a property named **type** in *subitem*, and the first such property has a [value](#) that is not an [item](#) and whose value consists only of [ASCII alphanumeric](#), then add a parameter named "TYPE" whose value is the [value](#) of that property to *parameters*.

If the property's [value](#) is not an [item](#) and its *name* is [sex](#)

If this is the first such property to be found, set *sex* to the property's [value](#).

If the property's [value](#) is not an [item](#) and its *name* is [gender-identity](#)

If this is the first such property to be found, set *gender-identity* to the property's [value](#).

Otherwise (the property's [value](#) is not an [item](#))

1. Let *value* be the property's [value](#).
2. If *element* is one of the [URL property elements](#), add a parameter with the name "VALUE" and the value "URI" to *parameters*.
3. Otherwise, if *name* is [bday](#) or [anniversary](#) and the *value* is a

[valid date string](#), add a parameter with the name "VALUE" and the value "DATE" to *parameters*.

4. Otherwise, if *name* is [rev](#) and the *value* is a [valid global date and time string](#), add a parameter with the name "VALUE" and the value "DATE-TIME" to *parameters*.
5. Prefix every U+005C REVERSE SOLIDUS character () in *value* with another U+005C REVERSE SOLIDUS character ()�.
6. Prefix every U+002C COMMA character (,) in *value* with a U+005C REVERSE SOLIDUS character ()�.
7. Unless *name* is [geo](#), prefix every U+003B SEMICOLON character (;) in *value* with a U+005C REVERSE SOLIDUS character ()�.
8. Replace every U+000D CARRIAGE RETURN U+000A LINE FEED character pair (CRLF) in *value* with a U+005C REVERSE SOLIDUS character ()� followed by a U+006E LATIN SMALL LETTER N character (n).
9. Replace every remaining U+000D CARRIAGE RETURN (CR) or U+000A LINE FEED (LF) character in *value* with a U+005C REVERSE SOLIDUS character ()� followed by a U+006E LATIN SMALL LETTER N character (n).
3. [Add a vCard line](#) with the type *name*, the parameters *parameters*, and the value *value* to *output*.
12. If either *sex* or *gender-identity* has a value that is not the empty string, [add a vCard line](#) with the type "GENDER" and the value consisting of the concatenation of *sex*, a U+003B SEMICOLON character (;), and *gender-identity* to *output*.
13. [Add a vCard line](#) with the type "END" and the value "VCARD" to *output*.

When the above algorithm says that the user agent is to *add a vCard line* consisting of a type *type*, optionally some *parameters*, and a value *value* to a string *output*, it must run the following steps:

1. Let *line* be an empty string.
2. Append *type*, [converted to ASCII uppercase](#), to *line*.
3. If there are any *parameters*, then for each *parameter*, in the order that they were added, run these substeps:
 1. Append a U+003B SEMICOLON character (;) to *line*.

2. Append the parameter's name to *line*.
3. Append a U+003D EQUALS SIGN character (=) to *line*.
4. Append the parameter's value to *line*.
4. Append a U+003A COLON character (:) to *line*.
5. Append *value* to *line*.
6. Let *maximum length* be 75.
7. While *line*'s [code point length](#) is greater than *maximum length*:
 1. Append the first *maximum length* code points of *line* to *output*.
 2. Remove the first *maximum length* code points from *line*.
 3. Append a U+000D CARRIAGE RETURN character (CR) to *output*.
 4. Append a U+000A LINE FEED character (LF) to *output*.
 5. Append a U+0020 SPACE character to *output*.
 6. Let *maximum length* be 74.
8. Append (what remains of) *line* to *output*.
9. Append a U+000D CARRIAGE RETURN character (CR) to *output*.
10. Append a U+000A LINE FEED character (LF) to *output*.

When the steps above require the user agent to obtain the result of *collecting vCard subproperties* named *subname* in *subitem*, the user agent must run the following steps:

1. Let *value* be the empty string.
2. For each property named *subname* in the item *subitem*, run the following substeps:
 1. If the [value](#) of the property is itself an [item](#), then skip this property.
 2. If this is not the first property named *subname* in *subitem* (ignoring any that were skipped by the previous step), then append a U+002C COMMA character (,) to *value*.
 3. Append the result of [escaping the vCard text string](#) given by the [value](#) of the property to *value*.

3. Return value.

When the steps above require the user agent to obtain the result of *collecting the first vCard subproperty named subname in subitem*, the user agent must run the following steps:

1. If there are no properties named *subname* in *subitem*, then return the empty string.
2. If the [value](#) of the first property named *subname* in *subitem* is an [item](#), then return the empty string.
3. Return the result of [escaping the vCard text string](#) given by the [value](#) of the first property named *subname* in *subitem*.

When the above algorithms say the user agent is to *escape the vCard text string value*, the user agent must use the following steps:

1. Prefix every U+005C REVERSE SOLIDUS character (\) in *value* with another U+005C REVERSE SOLIDUS character (\).
2. Prefix every U+002C COMMA character (,) in *value* with a U+005C REVERSE SOLIDUS character (\).
3. Prefix every U+003B SEMICOLON character (;) in *value* with a U+005C REVERSE SOLIDUS character (\).
4. Replace every U+000D CARRIAGE RETURN U+000A LINE FEED character pair (CRLF) in *value* with a U+005C REVERSE SOLIDUS character (\) followed by a U+006E LATIN SMALL LETTER N character (n).
5. Replace every remaining U+000D CARRIAGE RETURN (CR) or U+000A LINE FEED (LF) character in *value* with a U+005C REVERSE SOLIDUS character (\) followed by a U+006E LATIN SMALL LETTER N character (n).
6. Return the mutated *value*.

This algorithm can generate invalid vCard output, if the input does not conform to the rules described for the [item type](http://microformats.org/profile/hcard) and [defined property names](#).

5.3.1.2 Examples

This section is non-normative.

Here is a long example vCard for a fictional character called "Jack Bauer":

```
<section id="jack" itemscope itemtype="http://microformats.org/profile/hcard">
  <h1 itemprop="fn">
    <span itemprop="n" itemscope>
```

```

<span itemprop="given-name">Jack</span>
<span itemprop="family-name">Bauer</span>
</span>
</h1>

<p itemprop="org" itemscope>
  <span itemprop="organization-name">Counter-Terrorist Unit</span>
  (<span itemprop="organization-unit">Los Angeles Division</span>)
</p>
<p>
  <span itemprop="adr" itemscope>
    <span itemprop="street-address">10201 W. Pico Blvd.</span><br>
    <span itemprop="locality">Los Angeles</span>,
    <span itemprop="region">CA</span>
    <span itemprop="postal-code">90064</span><br>
    <span itemprop="country-name">United States</span><br>
  </span>
  <span itemprop="geo">34.052339; -118.410623</span>
</p>
<h2>Assorted Contact Methods</h2>
<ul>
  <li itemprop="tel" itemscope>
    <span itemprop="value">+1 (310) 597 3781</span> <span itemprop="type">work</span>
    <meta itemprop="type" content="voice">
  </li>
  <li><a itemprop="url" href="https://en.wikipedia.org/wiki/Jack_Bauer">I'm on Wikipedia</a>
    so you can leave a message on my user talk page.</li>
  <li><a itemprop="url" href="http://www.jackbauerfacts.com/">Jack Bauer Facts</a>
  <li itemprop="email"><a href="mailto:j.bauer@la.ctu.gov.invalid">j.bauer@la.ctu.gov</a>
  <li itemprop="tel" itemscope>
    <span itemprop="value">+1 (310) 555 3781</span> <span itemprop="type">mobile phone</span>
  </li>
</ul>
<ins datetime="2008-07-20 21:00:00+01:00">
  <meta itemprop="rev" content="2008-07-20 21:00:00+01:00">
  <p itemprop="tel" itemscope><strong>Update!</strong>
    My new <span itemprop="type">home</span> phone number is
    <span itemprop="value">01632 960 123</span>.</p>
</ins>
</section>

```

The odd line wrapping is needed because newlines are meaningful in microdata: newlines would be preserved in a conversion to, for example, the vCard format.

This example shows a site's contact details (using the [address](#) element) containing an address with two street components:

```

<address itemscope itemtype="http://microformats.org/profile/hcard">
  <strong itemprop="fn"><span itemprop="n" itemscope><span itemprop="given-name">
    <span itemprop="family-name">Person</span></span></strong> <br>
  <span itemprop="adr" itemscope>
    <span itemprop="street-address">1600 Amphitheatre Parkway</span> <br>
    <span itemprop="street-address">Building 43, Second Floor</span> <br>
    <span itemprop="locality">Mountain View</span>,
    <span itemprop="region">CA</span> <span itemprop="postal-code">94043</span>
  </span>
</address>

```

The vCard vocabulary can be used to just mark up people's names:

```

<span itemscope itemtype="http://microformats.org/profile/hcard">
  ><span itemprop="fn"><span itemprop="n" itemscope><span itemprop="given-name">
    >George</span> <span itemprop="family-name">Washington</span></span
  ></span></span>

```

This creates a single item with a two name-value pairs, one with the name "fn" and the value "George Washington", and the other with the name "n" and a second item as its value, the second item having the two name-value pairs "given-name" and "family-name" with the values "George" and "Washington" respectively. This is defined to map to the following vCard:

```

BEGIN:VCARD
PROFILE:VCARD
VERSION:4.0
SOURCE:document's address
FN:George Washington
N:Washington;George;;
END:VCARD

```

5.3.2 vEvent

An item with the [item type](#) <http://microformats.org/profile/hcalendar#vevent> represents an event.

This vocabulary does not [support global identifiers for items](#).

The following are the type's [defined property names](#). They are based on the vocabulary defined in *Internet Calendaring and Scheduling Core Object Specification (iCalendar)*, where more information on how to interpret the values can be found. [\[RFC5545\]](#)

Only the parts of the iCalendar vocabulary relating to events are used here; this vocabulary cannot express a complete iCalendar instance.

attach

Gives the address of an associated document for the event.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name **attach** may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

categories

Gives the name of a category or tag that the event could be classified as.

The [value](#) must be text.

Any number of properties with the name **categories** may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

class

Gives the access classification of the information regarding the event.

The [value](#) must be text with one of the following values:

- **public**
- **private**
- **confidential**

This is merely advisory and cannot be considered a confidentiality measure.

A single property with the name **class** may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

comment

Gives a comment regarding the event.

The [value](#) must be text.

Any number of properties with the name **comment** may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

description

Gives a detailed description of the event.

The [value](#) must be text.

A single property with the name [description](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

geo

Gives the geographical position of the event.

The [value](#) must be text and must match the following syntax:

1. Optionally, either a U+002B PLUS SIGN character (+) or a U+002D HYPHEN-MINUS character (-).
2. One or more [ASCII digits](#).
3. Optionally*, a U+002E FULL STOP character (.) followed by one or more [ASCII digits](#).
4. A U+003B SEMICOLON character (;).
5. Optionally, either a U+002B PLUS SIGN character (+) or a U+002D HYPHEN-MINUS character (-).
6. One or more [ASCII digits](#).
7. Optionally*, a U+002E FULL STOP character (.) followed by one or more [ASCII digits](#).

The optional components marked with an asterisk (*) should be included, and should have six digits each.

The value specifies latitude and longitude, in that order (i.e., "LAT LON" ordering), in decimal degrees. The longitude represents the location east and west of the prime meridian as a positive or negative real number, respectively. The latitude represents the location north and south of the equator as a positive or negative real number, respectively.

A single property with the name [geo](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

location

Gives the location of the event.

The [value](#) must be text.

A single property with the name [location](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

resources

Gives a resource that will be needed for the event.

The [value](#) must be text.

Any number of properties with the name [resources](#) may be present within each [item](#)

with the type <http://microformats.org/profile/hcalendar#vevent>.

status

Gives the confirmation status of the event.

The [value](#) must be text with one of the following values:

- **tentative**
- **confirmed**
- **cancelled**

A single property with the name [status](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

summary

Gives a short summary of the event.

The [value](#) must be text.

User agents should replace U+000A LINE FEED (LF) characters in the [value](#) by U+0020 SPACE characters when using the value.

A single property with the name [summary](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

dtend

Gives the date and time by which the event ends.

If the property with the name [dtend](#) is present within an [item](#) with the type <http://microformats.org/profile/hcalendar#vevent> that has a property with the name [dtstart](#) whose value is a [valid date string](#), then the [value](#) of the property with the name [dtend](#) must be text that is a [valid date string](#) also. Otherwise, the [value](#) of the property must be text that is a [valid global date and time string](#).

In either case, the [value](#) be later in time than the value of the [dtstart](#) property of the same [item](#).

The time given by the [dtend](#) property is not inclusive. For day-long events, therefore, the [dtend](#) property's [value](#) will be the day *after* the end of the event.

A single property with the name [dtend](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>, so long as that <http://microformats.org/profile/hcalendar#vevent> does not have a property with the name [duration](#).

dtstart

Gives the date and time at which the event starts.

The [value](#) must be text that is either a [valid date string](#) or a [valid global date and time string](#).

Exactly one property with the name [**dtstart**](#) must be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

duration

Gives the duration of the event.

The [value](#) must be text that is a [valid vevent duration string](#).

The duration represented is the sum of all the durations represented by integers in the value.

A single property with the name [**duration**](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>, so long as that <http://microformats.org/profile/hcalendar#vevent> does not have a property with the name [**dtend**](#).

transp

Gives whether the event is to be considered as consuming time on a calendar, for the purpose of free-busy time searches.

The [value](#) must be text with one of the following values:

- opaque
- transparent

A single property with the name [**transp**](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

contact

Gives the contact information for the event.

The [value](#) must be text.

Any number of properties with the name [**contact**](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

url

Gives a [URL](#) for the event.

The [value](#) must be an [absolute URL](#).

A single property with the name [**url**](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

uid

Gives a globally unique identifier corresponding to the event.

The [value](#) must be text.

A single property with the name [**uid**](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

exdate

Gives a date and time at which the event does not occur despite the recurrence rules.

The [value](#) must be text that is either a [valid date string](#) or a [valid global date and time string](#).

Any number of properties with the name [**exdate**](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

rdate

Gives a date and time at which the event recurs.

The [value](#) must be text that is one of the following:

- A [valid date string](#).
- A [valid global date and time string](#).
- A [valid global date and time string](#) followed by a U+002F SOLIDUS character (/) followed by a second [valid global date and time string](#) representing a later time.
- A [valid global date and time string](#) followed by a U+002F SOLIDUS character (/) followed by a [valid vevent duration string](#).

Any number of properties with the name [**rdate**](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

rrule

Gives a rule for finding dates and times at which the event occurs.

The [value](#) must be text that matches the RECUR value type defined in *iCalendar*.
[\[RFC5545\]](#)

A single property with the name [rrule](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

created

Gives the date and time at which the event information was first created in a calendaring system.

The [value](#) must be text that is a [valid global date and time string](#).

A single property with the name [created](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

last-modified

Gives the date and time at which the event information was last modified in a calendaring system.

The [value](#) must be text that is a [valid global date and time string](#).

A single property with the name [last-modified](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

sequence

Gives a revision number for the event information.

The [value](#) must be text that is a [valid non-negative integer](#).

A single property with the name [sequence](#) may be present within each [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>.

A string is a *valid vevent duration string* if it matches the following pattern:

1. A U+0050 LATIN CAPITAL LETTER P character (P).
2. One of the following:
 - A [valid non-negative integer](#) followed by a U+0057 LATIN CAPITAL LETTER W character (W). The integer represents a duration of that number of weeks.
 - At least one, and possible both in this order, of the following:
 1. A [valid non-negative integer](#) followed by a U+0044 LATIN CAPITAL LETTER D character (D). The integer represents a duration of that number of days.
 2. A U+0054 LATIN CAPITAL LETTER T character (T) followed by any one of the following, or the first and second of the following in that order, or the second and third of the following in that order, or all three

of the following in this order:

1. A [valid non-negative integer](#) followed by a U+0048 LATIN CAPITAL LETTER H character (H). The integer represents a duration of that number of hours.
2. A [valid non-negative integer](#) followed by a U+004D LATIN CAPITAL LETTER M character (M). The integer represents a duration of that number of minutes.
3. A [valid non-negative integer](#) followed by a U+0053 LATIN CAPITAL LETTER S character (S). The integer represents a duration of that number of seconds.

5.3.2.1 Conversion to iCalendar

Given a list of nodes *nodes* in a [Document](#), a user agent must run the following algorithm to extract any vEvent data represented by those *nodes*:

1. If none of the nodes in *nodes* are [items](#) with the type <http://microformats.org/profile/hcalendar#vevent>, then there is no vEvent data. Abort the algorithm, returning nothing.
2. Let *output* be an empty string.
3. [Add an iCalendar line](#) with the type "BEGIN" and the value "VCALENDAR" to *output*.
4. [Add an iCalendar line](#) with the type "PRODID" and the value equal to a user-agent-specific string representing the user agent to *output*.
5. [Add an iCalendar line](#) with the type "VERSION" and the value "2.0" to *output*.
6. For each node *node* in *nodes* that is an [item](#) with the type <http://microformats.org/profile/hcalendar#vevent>, run the following steps:
 1. [Add an iCalendar line](#) with the type "BEGIN" and the value "VEVENT" to *output*.
 2. [Add an iCalendar line](#) with the type "DTSTAMP" and a value consisting of an iCalendar DATE-TIME string representing the current date and time, with the annotation "VALUE=DATE-TIME", to *output*. [\[RFC5545\]](#)
 3. For each element *element* that is [a property of the item](#) *node*: for each name *name* in *element*'s [property names](#), run the appropriate set of substeps from the following list:

If the property's [value](#) is an [item](#)

Skip the property.

If the property is **[dtend](#)**
If the property is **[dtstart](#)**
If the property is **[exdate](#)**
If the property is **[rdate](#)**
If the property is **[created](#)**
If the property is **[last-modified](#)**

Let *value* be the result of stripping all U+002D HYPHEN-MINUS (-) and U+003A COLON (:) characters from the property's [value](#).

If the property's [value](#) is a [valid date string](#) then [add an iCalendar line](#) with the type *name* and the value *value* to *output*, with the annotation "VALUE=DATE".

Otherwise, if the property's [value](#) is a [valid global date and time string](#) then [add an iCalendar line](#) with the type *name* and the value *value* to *output*, with the annotation "VALUE=DATE-TIME".

Otherwise skip the property.

Otherwise

[Add an iCalendar line](#) with the type *name* and the property's [value](#) to *output*.

4. [Add an iCalendar line](#) with the type "END" and the value "VEVENT" to *output*.
7. [Add an iCalendar line](#) with the type "END" and the value "VCALENDAR" to *output*.

When the above algorithm says that the user agent is to *add an iCalendar line* consisting of a type *type*, a value *value*, and optionally an annotation, to a string *output*, it must run the following steps:

1. Let *line* be an empty string.
2. Append *type*, [converted to ASCII uppercase](#), to *line*.
3. If there is an annotation:
 1. Append a U+003B SEMICOLON character (;) to *line*.
 2. Append the annotation to *line*.
4. Append a U+003A COLON character (:) to *line*.
5. Prefix every U+005C REVERSE SOLIDUS character (\) in *value* with another U+005C REVERSE SOLIDUS character (\).

6. Prefix every U+002C COMMA character (,) in *value* with a U+005C REVERSE SOLIDUS character (\).
7. Prefix every U+003B SEMICOLON character (;) in *value* with a U+005C REVERSE SOLIDUS character (\).
8. Replace every U+000D CARRIAGE RETURN U+000A LINE FEED character pair (CRLF) in *value* with a U+005C REVERSE SOLIDUS character (\) followed by a U+006E LATIN SMALL LETTER N character (n).
9. Replace every remaining U+000D CARRIAGE RETURN (CR) or U+000A LINE FEED (LF) character in *value* with a U+005C REVERSE SOLIDUS character (\) followed by a U+006E LATIN SMALL LETTER N character (n).
10. Append *value* to *line*.
11. Let *maximum length* be 75.
12. While *line*'s [code point length](#) is greater than *maximum length*:
 1. Append the first *maximum length* code points of *line* to *output*.
 2. Remove the first *maximum length* code points from *line*.
 3. Append a U+000D CARRIAGE RETURN character (CR) to *output*.
 4. Append a U+000A LINE FEED character (LF) to *output*.
 5. Append a U+0020 SPACE character to *output*.
 6. Let *maximum length* be 74.
13. Append (what remains of) *line* to *output*.
14. Append a U+000D CARRIAGE RETURN character (CR) to *output*.
15. Append a U+000A LINE FEED character (LF) to *output*.

This algorithm can generate invalid iCalendar output, if the input does not conform to the rules described for the <http://microformats.org/profile/hcalendar#vevent> item type and [defined property names](#).

5.3.2.2 Examples

This section is non-normative.

Here is an example of a page that uses the vEvent vocabulary to mark up an event:

```

<body itemscope itemtype="http://microformats.org/profile/hcalendar#vevent">
...
<h1 itemprop="summary">Bluesday Tuesday: Money Road</h1>
...
<time itemprop="dtstart" datetime="2009-05-05T19:00:00Z">May 5th @ 7pm</time>
(until <time itemprop="dtend" datetime="2009-05-05T21:00:00Z">9pm</time>)
...
<a href="http://livebrum.co.uk/2009/05/05/bluesday-tuesday-money-road"
    rel="bookmark" itemprop="url">Link to this page</a>
...
<p>Location: <span itemprop="location">The RoadHouse</span></p>
...
<p><input type=button value="Add to Calendar"
    onclick="location = getCalendar(this)"></p>
...
<meta itemprop="description" content="via livebrum.co.uk">
</body>

```

The `getCalendar()` function is left as an exercise for the reader.

The same page could offer some markup, such as the following, for copy-and-pasting into blogs:

```

<div itemscope itemtype="http://microformats.org/profile/hcalendar#vevent">
<p>I'm going to
<strong itemprop="summary">Bluesday Tuesday: Money Road</strong>,
<time itemprop="dtstart" datetime="2009-05-05T19:00:00Z">May 5th at 7pm</time>
to <time itemprop="dtend" datetime="2009-05-05T21:00:00Z">9pm</time>,
at <span itemprop="location">The RoadHouse</span>!</p>
<p><a href="http://livebrum.co.uk/2009/05/05/bluesday-tuesday-money-road"
    itemprop="url">See this event on livebrum.co.uk</a>. </p>
<meta itemprop="description" content="via livebrum.co.uk">
</div>

```

5.3.3 Licensing works

An item with the [item type `http://n.whatwg.org/work`](http://n.whatwg.org/work) represents a work (e.g. an article, an image, a video, a song, etc.). This type is primarily intended to allow authors to include licensing information for works.

The following are the type's [defined property names](#).

`work`

Identifies the work being described.

The [value](#) must be an [absolute URL](#).

Exactly one property with the name [work](#) must be present within each [item](#) with the type <http://n.whatwg.org/work>.

title

Gives the name of the work.

A single property with the name [title](#) may be present within each [item](#) with the type <http://n.whatwg.org/work>.

author

Gives the name or contact information of one of the authors or creators of the work.

The [value](#) must be either an [item](#) with the type <http://microformats.org/profile/hcard>, or text.

Any number of properties with the name [author](#) may be present within each [item](#) with the type <http://n.whatwg.org/work>.

license

Identifies one of the licenses under which the work is available.

The [value](#) must be an [absolute URL](#).

Any number of properties with the name [license](#) may be present within each [item](#) with the type <http://n.whatwg.org/work>.

5.3.3.1 Examples

This section is non-normative.

This example shows an embedded image entitled *My Pond*, licensed under the Creative Commons Attribution-Share Alike 4.0 International License and the MIT license simultaneously.

```
<figure itemscope itemtype="http://n.whatwg.org/work">
  
  <figcaption>
    <p><cite itemprop="title">My Pond</cite></p>
    <p><small>Licensed under the <a itemprop="license"
      href="https://creativecommons.org/licenses/by-sa/4.0/">Creative
      Commons Attribution-Share Alike 4.0 International License</a>
      and the <a itemprop="license"
      href="http://www.opensource.org/licenses/mit-license.php">MIT
      license</a>.</small>
```

```
</figcaption>
</figure>
```

5.4 Converting HTML to other formats

5.4.1 JSON

Given a list of nodes *nodes* in a [Document](#), a user agent must run the following algorithm to extract the microdata from those nodes into a JSON form:

1. Let *result* be an empty object.
2. Let *items* be an empty array.
3. For each *node* in *nodes*, check if the element is a [top-level microdata item](#), and if it is then [get the object](#) for that element and add it to *items*.
4. Add an entry to *result* called "**items**" whose value is the array *items*.
5. Return the result of serializing *result* to JSON in the shortest possible way (meaning no whitespace between tokens, no unnecessary zero digits in numbers, and only using Unicode escapes in strings for characters that do not have a dedicated escape sequence), and with a lowercase "e" used, when appropriate, in the representation of any numbers. [\[JSON\]](#)

This algorithm returns an object with a single property that is an array, instead of just returning an array, so that it is possible to extend the algorithm in the future if necessary.

When the user agent is to get the object for an item *item*, optionally with a list of elements *memory*, it must run the following substeps:

1. Let *result* be an empty object.
2. If no *memory* was passed to the algorithm, let *memory* be an empty list.
3. Add *item* to *memory*.
4. If the *item* has any [item types](#), add an entry to *result* called "**type**" whose value is an array listing the [item types](#) of *item*, in the order they were specified on the [itemtype](#) attribute.
5. If the *item* has a [global identifier](#), add an entry to *result* called "**id**" whose value is the [global identifier](#) of *item*.
6. Let *properties* be an empty object.
7. For each element *element* that has one or more [property names](#) and is one of [the](#)

[properties of the item](#) *item*, in the order those elements are given by the algorithm that returns [the properties of an item](#), run the following substeps:

1. Let *value* be the [property value](#) of *element*.
2. If *value* is an [item](#), then: If *value* is in *memory*, then let *value* be the string "ERROR". Otherwise, [get the object](#) for *value*, passing a copy of *memory*, and then replace *value* with the object returned from those steps.
3. For each name *name* in *element's* [property names](#), run the following substeps:
 1. If there is no entry named *name* in *properties*, then add an entry named *name* to *properties* whose value is an empty array.
 2. Append *value* to the entry named *name* in *properties*.
8. Add an entry to *result* called "**properties**" whose value is the object *properties*.
9. Return *result*.

For example, take this markup:

```
<!DOCTYPE HTML>
<html lang="en">
<title>My Blog</title>
<article itemscope itemtype="http://schema.org/BlogPosting">
<header>
  <h1 itemprop="headline">Progress report</h1>
  <p><time itemprop="datePublished" datetime="2013-08-29">today</time></p>
  <link itemprop="url" href="?comments=0">
</header>
<p>All in all, he's doing well with his swim lessons. The biggest thing was putting his head in, but we got it down.</p>
<section>
  <h1>Comments</h1>
  <article itemprop="comment" itemscope itemtype="http://schema.org/UserComment">
    <link itemprop="url" href="#c1">
    <footer>
      <p>Posted by: <span itemprop="creator" itemscope itemtype="http://schema.org/UserProfile">
        <span itemprop="name">Greg</span>
      </span></p>
      <p><time itemprop="commentTime" datetime="2013-08-29">15 minutes ago</time>
    </footer>
    <p>Ha!</p>
  </article>
  <article itemprop="comment" itemscope itemtype="http://schema.org/UserComment">
    <link itemprop="url" href="#c2">
    <footer>
```

```

<p>Posted by: <span itemprop="creator" itemscope itemtype="http://schema.org/Person">
  <span itemprop="name">Charlotte</span>
</span></p>
<p><time itemprop="commentTime" datetime="2013-08-29">5 minutes ago</time>
</p>
<p>When you say "we got it down" . . .</p>
</article>
</section>
</article>

```

It would be turned into the following JSON by the algorithm above (supposing that the page's URL was <https://blog.example.com/progress-report>):

```

{
  "items": [
    {
      "type": [ "http://schema.org/BlogPosting" ],
      "properties": {
        "headline": [ "Progress report" ],
        "datePublished": [ "2013-08-29" ],
        "url": [ "https://blog.example.com/progress-report?comments=0" ],
        "comment": [
          {
            "type": [ "http://schema.org/UserComments" ],
            "properties": {
              "url": [ "https://blog.example.com/progress-report#c1" ],
              "creator": [
                {
                  "type": [ "http://schema.org/Person" ],
                  "properties": {
                    "name": [ "Greg" ]
                  }
                }
              ],
              "commentTime": [ "2013-08-29" ]
            }
          },
          {
            "type": [ "http://schema.org/UserComments" ],
            "properties": {
              "url": [ "https://blog.example.com/progress-report#c2" ],
              "creator": [
                {
                  "type": [ "http://schema.org/Person" ],
                  "properties": {
                    "name": [ "Charlotte" ]
                  }
                }
              ]
            }
          }
        ]
      }
    }
  ]
}

```

```
        }
      ],
      "commentTime": [ "2013-08-29" ]
    }
  ]
}
]
```

6 User interaction

6.1 The **hidden** attribute



Global attributes/hidden

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

Opera Yes Edge Yes

Edge (Legacy)12+Internet Explorer11

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android 4+ Samsung Internet Yes Opera Android Yes

All [HTML elements](#) may have the `hidden` content attribute set. The `hidden` attribute is a [boolean attribute](#). When specified on an element, it indicates that the element is not yet, or is no longer, directly relevant to the page's current state, or that it is being used to declare content to be reused by other parts of the page as opposed to being directly accessed by the user. User agents should not render elements that have the `hidden` attribute specified. This requirement may be implemented indirectly through the style layer. For example, an HTML+CSS user agent could implement these requirements [using the rules suggested in the Rendering section](#).

Because this attribute is typically implemented using CSS, it's also possible to override it using CSS. For instance, a rule that applies 'display: block' to all elements will cancel the effects of the [hidden](#) attribute. Authors therefore have to take care when writing their style sheets to make sure that the attribute is still styled as expected.

In the following skeletal example, the attribute is used to hide the web game's main screen until the user logs in:

```
<h1>The Example Game</h1>
<section id="login">
  <h2>Login</h2>
```

```
<form>
  ...
  <!-- calls login() once the user's credentials have been checked -->
</form>
<script>
  function login() {
    // switch screens
    document.getElementById('login').hidden = true;
    document.getElementById('game').hidden = false;
  }
</script>
</section>
<section id="game" hidden>
  ...
</section>
```

The [hidden](#) attribute must not be used to hide content that could legitimately be shown in another presentation. For example, it is incorrect to use [hidden](#) to hide panels in a tabbed dialog, because the tabbed interface is merely a kind of overflow presentation — one could equally well just show all the form controls in one big page with a scrollbar. It is similarly incorrect to use this attribute to hide content just from one presentation — if something is marked [hidden](#), it is hidden from all presentations, including, for instance, screen readers.

Elements that are not themselves [hidden](#) must not [hyperlink](#) to elements that are [hidden](#). The [for](#) attributes of [label](#) and [output](#) elements that are not themselves [hidden](#) must similarly not refer to elements that are [hidden](#). In both cases, such references would cause user confusion.

Elements and scripts may, however, refer to elements that are [hidden](#) in other contexts.

For example, it would be incorrect to use the [href](#) attribute to link to a section marked with the [hidden](#) attribute. If the content is not applicable or relevant, then there is no reason to link to it.

It would be fine, however, to use the ARIA [aria-describedby](#) attribute to refer to descriptions that are themselves [hidden](#). While hiding the descriptions implies that they are not useful alone, they could be written in such a way that they are useful in the specific context of being referenced from the elements that they describe.

Similarly, a [canvas](#) element with the [hidden](#) attribute could be used by a scripted graphics engine as an off-screen buffer, and a form control could refer to a hidden [form](#) element using its [form](#) attribute.

Elements in a section hidden by the [hidden](#) attribute are still active, e.g. scripts and form controls in such sections still execute and submit respectively. Only their presentation to the user changes.

[HTMLElement/hidden](#)

Support in all current engines.

Firefox 1+ Safari 5.1+ Chrome 6+

Opera 11.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12+

The `hidden` IDL attribute must [reflect](#) the content attribute of the same name.

6.2 Page visibility

A [top-level browsing context](#) has a *system visibility state*, which is either "`hidden`" or "`visible`".

The [system visibility state](#) is determined by the user-agent, and represents, for example, whether the browser window is minimized, a browser tab is currently in the background, or a system element such as a task switcher obscures the page.

When a user-agent determines that the [system visibility state](#) for [top-level browsing context context](#) has changed to `newState`, it must [queue a task](#) on the [user interaction task source](#) to [update the visibility state](#) of all the [Document](#) objects in the [top-level browsing context's document family](#) with `newState`.

A [Document](#) has a *visibility state*, which is either "`hidden`" or "`visible`", initially set to "`hidden`".

The `visibilityState` getter steps are to return [this's visibility state](#).

The `hidden` getter steps are to return true if [this's visibility state](#) is "`hidden`", otherwise false.

To *update the visibility state of Document document to visibilityState*:

1. If *document's visibility state* equals *visibilityState*, then return.
2. Set *document's visibility state* to *visibilityState*.
3. Run any *page visibility change steps* which may be defined in other specifications, with [visibility state](#) and [document](#).

It would be better if specification authors sent a pull request to add calls from here into their specifications directly, instead of using the [page visibility change steps](#) hook, to ensure well-defined cross-specification call order. As of the time of this writing the

following specifications are known to have [page visibility change steps](#), which will be run in an unspecified order: *Device Posture API*, *Screen Orientation API*, and *Web NFC*.
[\[DEVICEPOSTURE\]](#) [\[SCREENORIENTATION\]](#) [\[WEBNFC\]](#)

4. Fire an event named [visibilitychange](#) at *document*, with its [bubbles](#) attribute initialized to true.

6.3 Inert subtrees

This section **does not** define or create any content attribute named "inert". This section merely defines an abstract concept of [inertness](#).

A node (in particular elements and text nodes) can be marked as *inert*. When a node is [inert](#), then the user agent must act as if the node was absent for the purposes of targeting user interaction events, may ignore the node for the purposes of [find-in-page](#), and may prevent the user from selecting text in that node. User agents should allow the user to override the restrictions on search and text selection, however.

For example, consider a page that consists of just a single [inert](#) paragraph positioned in the middle of a [body](#). If a user moves their pointing device from the [body](#) over to the [inert](#) paragraph and clicks on the paragraph, no [mouseover](#) event would be fired, and the [mousemove](#) and [click](#) events would be fired on the [body](#) element rather than the paragraph.

When a node is inert, it generally cannot be focused. Inert nodes that are [commands](#) will also get disabled.

While a [browsing context container](#) is marked as [inert](#), its [nested browsing context's active document](#), and all nodes in that [Document](#), must be marked as [inert](#).

An element is *expressly inert* if it is [inert](#) and its [node document](#) is not [inert](#).

A [Document](#) *document* is *blocked by a modal dialog subject* if *subject* is the topmost [dialog](#) element in *document's top layer*. While *document* is so blocked, every node that is [connected](#) to *document*, with the exception of the *subject* element and its [shadow-including descendants](#), must be marked [inert](#). (The elements excepted by this paragraph can additionally be marked [inert](#) through other means; being part of a modal dialog does not "protect" a node from being marked [inert](#).)

The [dialog](#) element's [showModal\(\)](#) method causes this mechanism to trigger, by [adding](#) the [dialog](#) element to its [node document's top layer](#).

6.4 Tracking user activation

To prevent abuse of certain APIs that could be annoying to users (e.g., opening popups or vibrating phones), user agents allow these APIs only when the user is actively interacting with the web page or has interacted with the page at least once. This "active interaction" state is maintained through the mechanisms defined in this section.

6.4.1 Data model

For the purpose of tracking user activation, each [Window](#) W has a *last activation timestamp*. This is a number indicating the last time W got an [activation notification](#). It corresponds to a [DOMHighResTimeStamp](#) value except for two cases: positive infinity indicates that W has never been activated, while negative infinity indicates that a [user activation-gated API](#) has [consumed](#) the last user activation of W . The initial value is positive infinity.

A user agent also defines a *transient activation duration*, which is a constant number indicating how long a user activation is available for certain [user activation-gated APIs](#) (e.g., for opening popups).

The [transient activation duration](#) is expected to be at most a few seconds, so that the user can possibly perceive the link between an interaction with the page and the page calling the activation-gated API.

These two values imply two boolean user activation states for W :

Sticky activation

When the [current high resolution time](#) is greater than or equal to the [last activation timestamp](#) in W , W is said to have [sticky activation](#).

This is W 's historical activation state, indicating whether the user has ever interacted in W . It starts false, then changes to true (and never changes back to false) when W gets the very first [activation notification](#).

Transient activation

When the [current high resolution time](#) is greater than or equal to the [last activation timestamp](#) in W , and less than the [last activation timestamp](#) in W plus the [transient activation duration](#), then W is said to have [transient activation](#).

This is W 's current activation state, indicating whether the user has interacted in W recently. This starts with a false value, and remains true for a limited time after every [activation notification](#) W gets.

The [transient activation](#) state is considered *expired* if it becomes false because the [transient activation duration](#) time has elapsed since the last user activation. Note that it can become false even before the expiry time through an [activation consumption](#).

6.4.2 Processing model

When a user interaction in a [browsing context](#) B causes firing of an [activation triggering input event](#) in B 's [active document](#) D , the user agent must perform the following *activation notification steps before dispatching* the event:

1. Let *browsingContexts* be a list consisting of:
 - *B*,
 - all [ancestor browsing contexts](#) of *B*, and
 - all the [descendant browsing contexts](#) of *D* that have [active documents](#) from the [same origin](#) as that of *D*.
2. Let *windows* be the list of [Window](#) objects constructed by taking the [active window](#) of each item in *browsingContexts*.
3. [For each](#) *window* in *windows*, set *window*'s [last activation timestamp](#) to the [current high resolution time](#).

An *activation triggering input event* is any event whose [isTrusted](#) attribute is true and whose [type](#) is one of:

- [keydown](#), provided the key is neither the **Esc** key nor a shortcut key reserved by the user agent.
- [mousedown](#).
- [pointerdown](#), provided the event's [pointerType](#) is "mouse".
- [pointerup](#), provided the event's [pointerType](#) is not "mouse".
- [touchend](#).

[Activation consuming APIs](#) defined in this and other specifications can *consume user activation* by performing the following steps, given a [Window](#) *W*:

1. If *W*'s [browsing context](#) is null, then return.
2. Let *top* be *W*'s [browsing context](#)'s [top-level browsing context](#).
3. Let *browsingContexts* be the [list of the descendant browsing contexts](#) of *top*'s [active document](#).
4. [Append](#) *top* to *browsingContexts*.
5. Let *windows* be the list of [Window](#) objects constructed by taking the [active window](#) of each item in *browsingContexts*.
6. [For each](#) *window* in *windows*, if *window*'s [last activation timestamp](#) is not positive infinity, then set *window*'s [last activation timestamp](#) to negative infinity.

The spec is not clear about how to traverse a tree of documents. See [issue #5020](#).

Note the asymmetry in the sets of [browsing contexts](#) in the page that are affected by an [activation notification](#) vs an [activation consumption](#): an activation consumption changes (to false) the [transient activation](#) states for all browsing contexts in the page, but an activation

notification changes (to true) the states for a subset of those browsing contexts. The exhaustive nature of consumption here is deliberate: it prevents malicious sites from making multiple calls to an [activation consuming API](#) from a single user activation (possibly by exploiting a deep hierarchy of [iframe](#)s).

6.4.3 APIs gated by user activation

APIs that are dependent on user activation are classified into three different levels. The levels are as follows, sorted by their "strength of dependence" on user activation (from weakest to strongest):

Sticky activation-gated APIs

These APIs require the [sticky activation](#) state to be true, so they are blocked until the very first user activation.

Transient activation-gated APIs

These APIs require the [transient activation](#) state to be true, but they don't [consume](#) it, so multiple calls are allowed per user activation until the transient state [expires](#).

Transient activation-consuming APIs

These APIs require the [transient activation](#) state to be true, and they [consume user activation](#) in each call to prevent multiple calls per user activation.

6.5 Activation behavior of elements

Certain elements in HTML have an [activation behavior](#), which means that the user can activate them. This is always caused by a [click](#) event.

The user agent should allow the user to manually trigger elements that have an [activation behavior](#), for instance using keyboard or voice input, or through mouse clicks. When the user triggers an element with a defined [activation behavior](#) in a manner other than clicking it, the default action of the interaction event must be to [fire a click event](#) at the element.

`element.click()`



[HTMLElement.click](#)

Support in all current engines.

Firefox 3+ | Safari 6+ | Chrome 9+

Opera 10.5+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 5.5+

Firefox Android4+Safari iOS6+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

Acts as if the element was clicked.

Each element has an associated *click in progress flag*, which is initially unset.

The `click()` method must run the following steps:

1. If this element is a form control that is [disabled](#), then return.
2. If this element's [click in progress flag](#) is set, then return.
3. Set this element's [click in progress flag](#).
4. [Fire a synthetic pointer event](#) named `click` at this element, with the *not trusted flag* set.
5. Unset this element's [click in progress flag](#).

6.6 Focus

6.6.1 Introduction

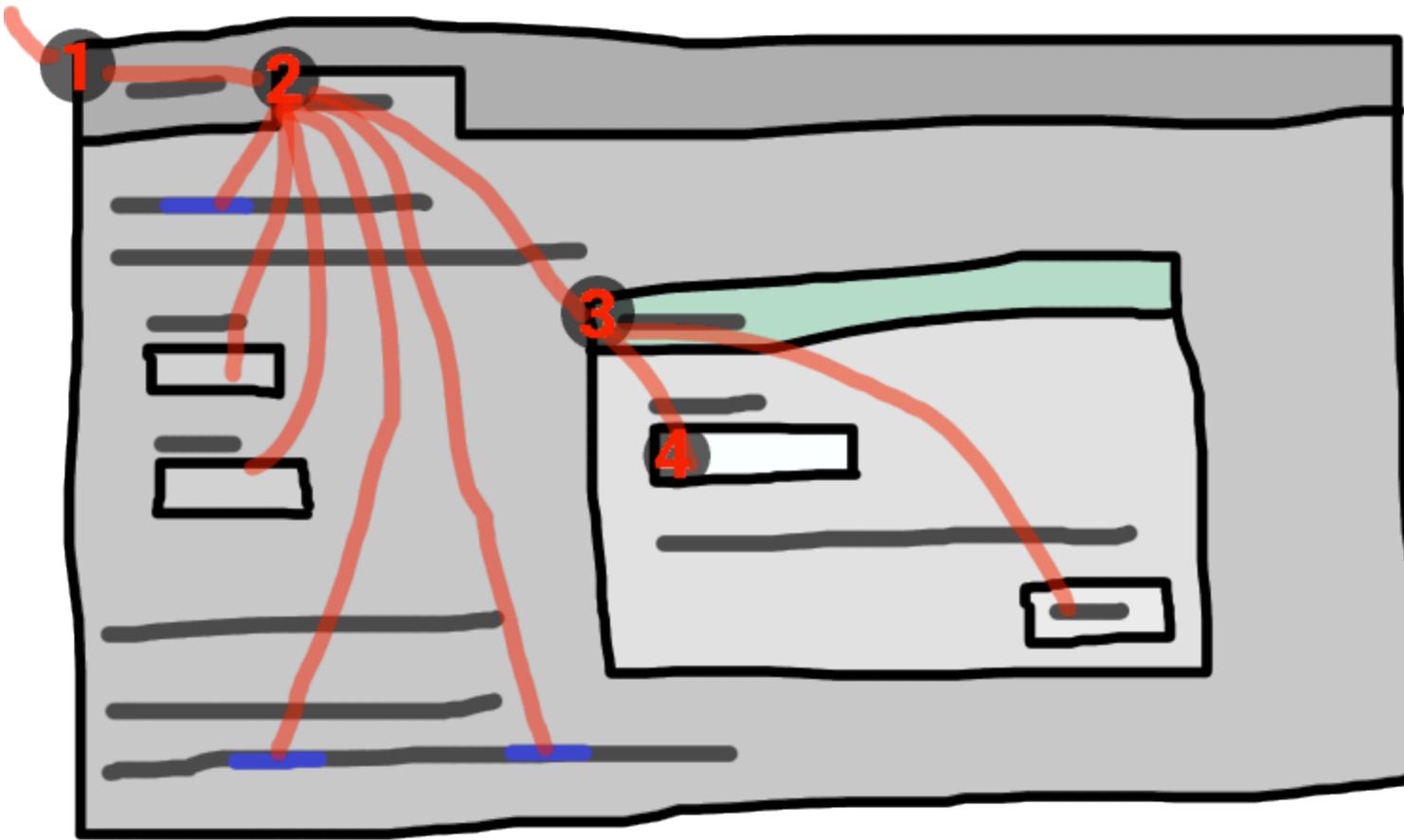
This section is non-normative.

An HTML user interface typically consists of multiple interactive widgets, such as form controls, scrollable regions, links, dialog boxes, browser tabs, and so forth. These widgets form a hierarchy, with some (e.g. browser tabs, dialog boxes) containing others (e.g. links, form controls).

When interacting with an interface using a keyboard, key input is channeled from the system, through the hierarchy of interactive widgets, to an active widget, which is said to be [focused](#).

Consider an HTML application running in a browser tab running in a graphical environment. Suppose this application had a page with some text controls and links, and was currently showing a modal dialog, which itself had a text control and a button.

The hierarchy of focusable widgets, in this scenario, would include the browser window, which would have, amongst its children, the browser tab containing the HTML application. The tab itself would have as its children the various links and text controls, as well as the dialog. The dialog itself would have as its children the text control and the button.



If the widget with [focus](#) in this example was the text control in the dialog box, then key input would be channeled from the graphical system to ① the web browser, then to ② the tab, then to ③ the dialog, and finally to ④ the text control.

Keyboard events are always targeted at this [focused](#) element.

6.6.2 Data model

A [top-level browsing context](#) has *system focus* when it can receive keyboard input channeled from the operating system.

System focus is lost when a browser window loses focus, but might also be lost to other system widgets in the browser window such as a URL bar.

The term *focusable area* is used to refer to regions of the interface that can further become the target of such keyboard input. Focusable areas can be elements, parts of elements, or other regions managed by the user agent.

Each [focusable area](#) has a *DOM anchor*, which is a [Node](#) object that represents the position of the [focusable area](#) in the DOM. (When the [focusable area](#) is itself a [Node](#), it is its own [DOM anchor](#).) The [DOM anchor](#) is used in some APIs as a substitute for the [focusable area](#) when there is no other DOM object to represent the [focusable area](#).

The following table describes what objects can be [focusable areas](#). The cells in the left column describe objects that can be [focusable areas](#); the cells in the right column describe the [DOM anchors](#) for those elements. (The cells that span both columns are non-normative examples.)

Focusable area	Examples
Elements that meet all the following criteria:	
<ul style="list-style-type: none">the element's tabindex value is non-null, or the element is determined by the user agent to be focusable;the element is either not a shadow host, or has a shadow root whose delegates focus is false;<ul style="list-style-type: none">the element is not actually disabled;the element is not expressly inert;the element is either being rendered or being used as relevant canvas fallback content.	

[iframe](#), [`<input type="text">`](#), sometimes [``](#) (depending on platform conventions).

The shapes of [area](#) elements in an [image map](#) associated with an [img](#) element that is [being rendered](#) and is not [expressly inert](#). The [img](#) e

In the following example, the [area](#) element creates two shapes, one on each image. The [DOM anchor](#) of the first shape is the [img](#) element, and the [DOM anchor](#) of the second shape is the second [img](#) element.

```
<map id=wallmap><area alt="Enter Door" coords="10,10,100,200" href="door.htm
...
direction is forward</i>                        |                                                                                                                                                                                           | <i>direction is backward</i>                                                                                                                                                             |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>starting point</i> is a <u>browsing context</u> | Let <i>candidate</i> be the first <u>suitable sequentially focusable area</u> in <i>starting point's active document</i> , if any; or else null                                           | Let <i>candidate</i> be the last <u>suitable sequentially focusable area</u> in <i>starting point's active document</i> , if any; or else null                                           |
| <i>selection mechanism</i> is <u>DOM</u>           | Let <i>candidate</i> be the first <u>suitable sequentially focusable area</u> in the <u>home document</u> following <i>starting point</i> , if any; or else null                          | Let <i>candidate</i> be the last <u>suitable sequentially focusable area</u> in the <u>home document</u> preceding <i>starting point</i> , if any; or else null                          |
| <i>selection mechanism</i> is <u>sequential</u>    | Let <i>candidate</i> be the first <u>suitable sequentially focusable area</u> in the <u>home sequential focus navigation order</u> following <i>starting point</i> , if any; or else null | Let <i>candidate</i> be the last <u>suitable sequentially focusable area</u> in the <u>home sequential focus navigation order</u> preceding <i>starting point</i> , if any; or else null |

A *suitable sequentially focusable area* is a focusable area whose DOM anchor is not inert and is sequentially focusable.

The *home document* is the Document to which *starting point* belongs.

The *home sequential focus navigation order* is the sequential focus navigation order to which *starting point* belongs.

The home sequential focus navigation order is the home document's sequential focus navigation order, but is only used when the *starting point* is in that sequential focus navigation order (when it's not, *selection mechanism* will be *DOM*).

2. If *candidate* is a browsing context container with a non-null nested browsing context, then let *new candidate* be the result of running the sequential navigation search algorithm with *candidate's nested browsing context* as the first argument, *direction* as the second, and *sequential* as the third.

If *new candidate* is null, then let *starting point* be *candidate*, and return to the top of this algorithm. Otherwise, let *candidate* be *new candidate*.

3. Return *candidate*.

## 6.6.6 Focus management APIs

```
dictionary FocusOptions {
 boolean preventScroll = false;
};
```

**`documentOrShadowRoot.activeElement`**



[Document/activeElement](#)

Support in all current engines.

Firefox 3+ Safari 4+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 6+

---

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

[ShadowRoot/activeElement](#)

Support in all current engines.

Firefox 63+ Safari 10.1+ Chrome 53+

---

Opera 40+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 63+ Safari iOS 10.3+ Chrome Android 53+ WebView Android 53+ Samsung Internet 6.0+ Opera Android 41+

Returns the deepest element in the document through which or to which key events are being routed. This is, roughly speaking, the focused element in the document.

For the purposes of this API, when a [child browsing context](#) is focused, its [container](#) is [focused](#) in the [parent browsing context](#). For example, if the user moves the focus to a text control in an [iframe](#), the [iframe](#) is the element returned by the [activeElement](#) API in the [iframe](#)'s [node document](#).

Similarly, when the focused element is in a different [node tree](#) than `documentOrShadowRoot`, the element returned will be the [host](#) that's located in the same [node tree](#) as `documentOrShadowRoot` if `documentOrShadowRoot` is a [shadow-including inclusive ancestor](#) of the focused element, and null if not.

**`document.hasFocus()`**



[Document/hasFocus](#)

Support in all current engines.

Firefox 3+ Safari 4+ Chrome 1+

---

Opera 15+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 5.5+

---

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 14+

Returns true if key events are being routed through or to the document; otherwise, returns false. Roughly speaking, this corresponds to the document, or a document nested inside this one, being focused.

### `window.focus()`

✓MDN

#### [Window/focus](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Moves the focus to the window's [browsing context](#), if any.

### `element.focus([ { preventScroll: true } ])`

✓MDN

#### [HTMLElement/focus](#)

Support in all current engines.

Firefox 1.5+ Safari 3+ Chrome 1+

---

Opera 8+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 5.5+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung

Internet 1.0+ Opera Android 10.1+

Moves the focus to the element.

If the element is a [browsing context container](#), moves the focus to its [nested browsing context](#) instead.

By default, this method also scrolls the element into view. Providing the [preventScroll](#)

option and setting it to true prevents this behavior.

## `element.blur()`

✓MDN

### [HTMLElement.blur](#)

Support in all current engines.

Firefox 1.5+ Safari 3+ Chrome 1+

---

Opera 8+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 5.5+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.0+ Opera Android 10.1+

Moves the focus to the [viewport](#). Use of this method is discouraged; if you want to focus the [viewport](#), call the [focus\(\)](#) method on the [Document](#)'s [document element](#).

Do not use this method to hide the focus ring if you find the focus ring unsightly. Instead, use the [:focus-visible](#) pseudo-class to override the '[outline](#)' property, and provide a different way to show what element is focused. Be aware that if an alternative focusing style isn't made available, the page will be significantly less usable for people who primarily navigate pages using a keyboard, or those with reduced vision who use focus outlines to help them navigate the page.

For example, to hide the outline from [textarea](#) elements and instead use a yellow background to indicate focus, you could use:

```
textarea:focus-visible { outline: none; background: yellow; color: black;}
```

The [activeElement](#) attribute's getter must run these steps:

1. Let *candidate* be the [DOM anchor](#) of the [focused area](#) of this [DocumentOrShadowRoot](#)'s [node document](#).
2. Set *candidate* to the result of [retargeting](#) *candidate* against this [DocumentOrShadowRoot](#).
3. If *candidate*'s [root](#) is not this [DocumentOrShadowRoot](#), then return null.
4. If *candidate* is not a [Document](#) object, then return *candidate*.
5. If *candidate* has a [body element](#), then return that [body element](#).
6. If *candidate*'s [document element](#) is non-null, then return that [document element](#).
7. Return null.

The `hasFocus()` method on the [Document](#) object, when invoked, must return the result of running the [has focus steps](#) with the [Document](#) object as the argument.

The `focus()` method, when invoked, must run these steps:

1. Let *current* be this [Window](#) object's [browsing context](#).
2. If *current* is null, then return.
3. Run the [focusing steps](#) with *current*.
4. If *current* is a [top-level browsing context](#), user agents are encouraged to trigger some sort of notification to indicate to the user that the page is attempting to gain focus.



## [Window/blur](#)

Support in all current engines.

Firefox 1+ | Safari 1+ | Chrome 1+

---

Opera 12.1+ | Edge 79+

---

Edge (Legacy) 12+ | Internet Explorer 4+

---

Firefox | Android 4+ | Safari iOS 1+ | Chrome | Android 18+ | WebView | Android 1+ | Samsung Internet 1.0+ | Opera | Android 12.1+

The `blur()` method, when invoked, provides a hint to the user agent that the script believes the user probably is not currently interested in the contents of this [Window](#) object's [browsing context](#), if non-null, but that the contents might become interesting again in the future.

User agents are encouraged to ignore calls to this [blur\(\)](#) method entirely.

Historically, the [focus\(\)](#) and [blur\(\)](#) methods actually affected the system-level focus of the system widget (e.g., tab or window) that contained the [browsing context](#), but hostile sites widely abuse this behavior to the user's detriment.

The `focus(options)` method on elements, when invoked, must run the following steps:

1. If the element is marked as [locked for focus](#), then return.
2. Mark the element as *locked for focus*.
3. Run the [focusing steps](#) for the element.
4. If the value of the `preventScroll` dictionary member of *options* is false, then [scroll the element into view](#) with scroll behavior "`auto`", block flow direction position set to an [implementation-defined](#) value, and inline base direction position set to an [implementation-defined](#) value.

[implementation-defined](#) value.

5. Unmark the element as [locked for focus](#).

The **`blur()`** method, when invoked, should run the [unfocusing steps](#) for the element on which the method was called. User agents may selectively or uniformly ignore calls to this method for usability reasons.

For example, if the [blur\(\)](#) method is unwisely being used to remove the focus ring for aesthetics reasons, the page would become unusable by keyboard users. Ignoring calls to this method would thus allow keyboard users to interact with the page.

#### 6.6.7 The [autofocus](#) attribute

The **`autofocus`** content attribute allows the author to indicate that an element is to be focused as soon as the page is loaded or as soon as the [dialog](#) within which it finds itself is shown, allowing the user to just start typing without having to manually focus the main element.

The [autofocus](#) attribute is a [boolean attribute](#).

An element's *nearest ancestor autofocus scoping root element* is the element itself if the element is a [dialog](#) element, or else is the element's nearest ancestor [dialog](#) element, if any, or else is the element's last [inclusive ancestor](#) element.

There must not be two elements with the same [nearest ancestor autofocus scoping root element](#) that both have the [autofocus](#) attribute specified.

Each [Document](#) has an *autofocus candidates list*, initially empty.

Each [Document](#) has an *autofocus processed flag* boolean, initially false.

When an element with the [autofocus](#) attribute specified is [inserted into a document](#), run the following steps:

1. If the user has indicated (for example, by starting to type in a form control) that they do not wish focus to be changed, then optionally return.
2. Let *target* be the element's [node document](#).
3. If *target*'s [browsing context](#) is null, then return.
4. If *target*'s [active sandboxing flag set](#) has the [sandboxed automatic features browsing context flag](#), then return.
5. For each *ancestorBC* of *target*'s [browsing context](#)'s [ancestor browsing contexts](#): if *ancestorBC*'s [active document](#)'s [origin](#) is not [same origin](#) with *target*'s [origin](#), then

return.

6. Let *topDocument* be the [active document](#) of *target*'s [browsing context's top-level browsing context](#).
7. If *topDocument*'s [autofocus processed flag](#) is false, then [remove](#) the element from *topDocument*'s [autofocus candidates](#), and [append](#) the element to *topDocument*'s [autofocus candidates](#).

We do not check if an element is a [focusable area](#) before storing it in the [autofocus candidates](#) list, because even if it is not a focusable area when it is inserted, it could become one by the time [flush autofocus candidates](#) sees it.

To *flush autofocus candidates* for a document *topDocument*, run these steps:

1. If *topDocument*'s [autofocus processed flag](#) is true, then return.
2. Let *candidates* be *topDocument*'s [autofocus candidates](#).
3. If *candidates* [is empty](#), then return.
4. If *topDocument*'s [focused area](#) is not *topDocument* itself, or *topDocument* has non-null [target element](#), then:
  1. [Empty](#) *candidates*.
  2. Set *topDocument*'s [autofocus processed flag](#) to true.
  3. Return.
5. While *candidates* is not [empty](#):
  1. Let *element* be *candidates*[0].
  2. Let *doc* be *element*'s [node document](#).
  3. If *doc* is not [fully active](#), then [remove](#) *element* from *candidates*, and [continue](#).
  4. If *doc*'s [browsing context's top-level browsing context](#) is not same as *topDocument*'s [browsing context](#), then [remove](#) *element* from *candidates*, and [continue](#).
  5. If *doc*'s [script-blocking style sheet counter](#) is greater than 0, then return.
6. [Remove](#) *element* from *candidates*.

In this case, *element* is the currently-best candidate, but *doc* is not ready for autofocusing. We'll try again next time [flush autofocus candidates](#) is called.

7. Let *inclusiveAncestorDocuments* be a [list](#) consisting of *doc*, plus the [active documents](#) of each of *doc*'s [browsing context](#)'s [ancestor browsing contexts](#).
8. If any [Document](#) in *inclusiveAncestorDocuments* has non-null [target element](#), then [continue](#).
9. Let *target* be *element*.
10. If *target* is not a [focusable area](#), then set *target* to the result of [getting the focusable area](#) for *target*.

[Autofocus candidates](#) can [contain](#) elements which are not [focusable areas](#). In addition to the special cases handled in the [get the focusable area](#) algorithm, this can happen because a non-[focusable area](#) element with an [autofocus](#) attribute was [inserted into a document](#) and it never became focusable, or because the element was focusable but its status changed while it was stored in [autofocus candidates](#).

11. If *target* is not null, then:
  1. [Empty candidates](#).
  2. Set *topDocument*'s [autofocus processed flag](#) to true.
  3. Run the [focusing steps](#) for *target*.

This handles the automatic focusing during document load. The [show\(\)](#) and [showModal\(\)](#) methods of [dialog](#) elements also processes the [autofocus](#) attribute.

Focusing the element does not imply that the user agent has to focus the browser window if it has lost focus.

MDN

## [Global\\_attributes/autofocus](#)

Support in one engine only.

Firefox 1+ Safari 4+ Chrome 79+

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Opera 66+ Edge 79+

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Edge (Legacy) No Internet Explorer 10+

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Firefox Android 4+ Safari iOS 3.2+ Chrome Android 79+ WebView Android 79+ Samsung Internet 12.0+ Opera Android 57+

The [autofocus](#) IDL attribute must [reflect](#) the content attribute of the same name.

In the following snippet, the text control would be focused when the document was loaded.

```
<input maxlength="256" name="q" value="" autofocus>
<input type="submit" value="Search">
```

The [autofocus](#) attribute applies to all elements, not just to form controls. This allows examples such as the following:

```
<div contenteditable autofocus>Edit me!</div>
```

## 6.7 Assigning keyboard shortcuts

### 6.7.1 Introduction

*This section is non-normative.*

Each element that can be activated or focused can be assigned a single key combination to activate it, using the [accesskey](#) attribute.

The exact shortcut is determined by the user agent, based on information about the user's keyboard, what keyboard shortcuts already exist on the platform, and what other shortcuts have been specified on the page, using the information provided in the [accesskey](#) attribute as a guide.

In order to ensure that a relevant keyboard shortcut is available on a wide variety of input devices, the author can provide a number of alternatives in the [accesskey](#) attribute.

Each alternative consists of a single character, such as a letter or digit.

User agents can provide users with a list of the keyboard shortcuts, but authors are encouraged to do so also. The [accessKeyLabel](#) IDL attribute returns a string representing the actual key combination assigned by the user agent.

In this example, an author has provided a button that can be invoked using a shortcut key. To support full keyboards, the author has provided "C" as a possible key. To support devices equipped only with numeric keypads, the author has provided "1" as another possible key.

```
<input type=button value=Collect onclick="collect()"
 accesskey="C 1" id=c>
```

To tell the user what the shortcut key is, the author has this script here opted to explicitly add the key combination to the button's label:

```
function addShortcutKeyLabel(button) {
 if (button.accessKeyLabel != '')
 button.value += ' (' + button.accessKeyLabel + ')';
}
addShortcutKeyLabel(document.getElementById('c'));
```

Browsers on different platforms will show different labels, even for the same key combination, based on the convention prevalent on that platform. For example, if the key combination is the Control key, the Shift key, and the letter C, a Windows browser might display "Ctrl+Shift+C", whereas a Mac browser might display "⌃⇧C", while an Emacs browser might just display "C-C". Similarly, if the key combination is the Alt key and the Escape key, Windows might use "Alt+Esc", Mac might use "⌥Esc", and an Emacs browser might use "M-ESC" or "ESC ESC".

In general, therefore, it is unwise to attempt to parse the value returned from the [accessKeyLabel](#) IDL attribute.

### 6.7.2 The **accesskey** attribute



#### [Global\\_attributes/accesskey](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome Yes

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Opera Yes Edge Yes

---

Edge (Legacy) 12+ Internet Explorer Yes

---

Firefox Android Yes Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung Internet Yes Opera Android Yes

All [HTML elements](#) may have the [accesskey](#) content attribute set. The [accesskey](#) attribute's value is used by the user agent as a guide for creating a keyboard shortcut that activates or focuses the element.

If specified, the value must be an [ordered set of unique space-separated tokens](#) none of which are [identical to](#) another token and each of which must be exactly one code point in length.

In the following example, a variety of links are given with access keys so that keyboard users familiar with the site can more quickly navigate to the relevant pages:

```
<nav>
 <p>
 Consortium Activities
 Technical Reports and Recommendations
 Alphabetical Site Index
 About Consortium
 Contact Consortium
 </p>
</nav>
```

In the following example, the search field is given two possible access keys, "s" and "0" (in that

order). A user agent on a device with a full keyboard might pick **Ctrl+Alt+S** as the shortcut key, while a user agent on a small device with just a numeric keypad might pick just the plain unadorned key **0**:

```
<form action="/search">
 <label>Search: <input type="search" name="q" accesskey="s 0"></label>
 <input type="submit">
</form>
```

In the following example, a button has possible access keys described. A script then tries to update the button's label to advertise the key combination the user agent selected.

```
<input type=submit accesskey="N @ 1" value="Compose">
...
<script>
 function labelButton(button) {
 if (button.accessKeyLabel)
 button.value += ' (' + button.accessKeyLabel + ')';
 }
 var inputs = document.getElementsByTagName('input');
 for (var i = 0; i < inputs.length; i += 1) {
 if (inputs[i].type == "submit")
 labelButton(inputs[i]);
 }
</script>
```

On one user agent, the button's label might become "**Compose (⌘N)**". On another, it might become "**Compose (Alt+↑+1)**". If the user agent doesn't assign a key, it will be just "**Compose**". The exact string depends on what the [assigned access key](#) is, and on how the user agent represents that key combination.

### 6.7.3 Processing model

An element's *assigned access key* is a key combination derived from the element's [accesskey](#) content attribute. Initially, an element must not have an [assigned access key](#).

Whenever an element's [accesskey](#) attribute is set, changed, or removed, the user agent must update the element's [assigned access key](#) by running the following steps:

1. If the element has no [accesskey](#) attribute, then skip to the *fallback* step below.
2. Otherwise, [split the attribute's value on ASCII whitespace](#), and let *keys* be the resulting tokens.
3. For each value in *keys* in turn, in the order the tokens appeared in the attribute's value, run the following substeps:

1. If the value is not a string exactly one code point in length, then skip the remainder of these steps for this value.
2. If the value does not correspond to a key on the system's keyboard, then skip the remainder of these steps for this value.
3. (This is a tracking vector.) If the user agent can find a mix of zero or more modifier keys that, combined with the key that corresponds to the value given in the attribute, can be used as the access key, then the user agent may assign that combination of keys as the element's [assigned access key](#) and return.
4. *Fallback:* Optionally, the user agent may assign a key combination of its choosing as the element's [assigned access key](#) and then return.
5. If this step is reached, the element has no [assigned access key](#).

Once a user agent has selected and assigned an access key for an element, the user agent should not change the element's [assigned access key](#) unless the [accesskey](#) content attribute is changed or the element is moved to another [Document](#).

When the user presses the key combination corresponding to the [assigned access key](#) for an element, if the element [defines a command](#), the command's [Hidden State](#) facet is false (visible), the command's [Disabled State](#) facet is also false (enabled), the element is [in a document](#) that has a non-null [browsing context](#), and neither the element nor any of its ancestors has a [hidden](#) attribute specified, then the user agent must trigger the [Action](#) of the command.

User agents [might expose](#) elements that have an [accesskey](#) attribute in other ways as well, e.g. in a menu displayed in response to a specific key combination.



## [HTMLElement/accessKey](#)

Support in all current engines.

Firefox 5+ Safari 6+ Chrome 17+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 5+ Safari iOS 6+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.0+ Opera Android 12.1+

The [accessKey](#) IDL attribute must [reflect](#) the [accesskey](#) content attribute.



## [HTMLElement/accessKeyLabel](#)

Firefox 8+ Safari 14+ Chrome No

Opera No Edge No

Edge (Legacy) No Internet Explorer No

Firefox Android 8+ Safari iOS 14+ Chrome Android No WebView Android No Samsung

Internet No Opera Android No

The **accessKeyLabel** IDL attribute must return a string that represents the element's assigned access key, if any. If the element does not have one, then the IDL attribute must return the empty string.

## 6.8 Editing

### 6.8.1 Making document regions editable: The **contentEditable** content attribute

✓MDN

## [HTMLElement/contentEditable](#)

Support in all current engines.

Firefox 3+ Safari 3+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.0+ Opera Android 10.1+

```
interface mixin ElementContentEditable {
 [CEReactions] attribute DOMString contentEditable;
 [CEReactions] attribute DOMString enterKeyHint;
 readonly attribute boolean isContentEditable;
 [CEReactions] attribute DOMString inputMode;
};
```

✓MDN

## [Global\\_attributes/contenteditable](#)

Support in all current engines.

Firefox 3+ Safari Yes Chrome Yes

Opera 9+ Edge Yes

Edge (Legacy) 12+ Internet Explorer 5.5+

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

The **contenteditable** content attribute is an [enumerated attribute](#) whose keywords are the empty string, **true**, and **false**. The empty string and the **true** keyword map to the *true* state. The **false** keyword maps to the *false* state. In addition, there is a third state, the *inherit* state, which is the [missing value default](#) and the [invalid value default](#).

The *true* state indicates that the element is editable. The *inherit* state indicates that the element is editable if its parent is. The *false* state indicates that the element is not editable.

For example, consider a page that has a [form](#) and a [textarea](#) to publish a new article, where the user is expected to write the article using HTML:

```
<form method=POST>
<fieldset>
 <legend>New article</legend>
 <textarea name=article><p>Hello world.</p></textarea>
</fieldset>
<p><button>Publish</button></p>
</form>
```

When scripting is enabled, the [textarea](#) element could be replaced with a rich text control instead, using the [contenteditable](#) attribute:

```
<form method=POST>
<fieldset>
 <legend>New article</legend>
 <textarea id=textarea name=article><p>Hello world.</p></textarea>
 <div id=div style="white-space: pre-wrap" hidden><p>Hello world.</p></div>
<script>
 let textarea = document.getElementById("textarea");
 let div = document.getElementById("div");
 textarea.hidden = true;
 div.hidden = false;
 div.contentEditable = "true";
 div.oninput = (e) => {
 textarea.value = div.innerHTML;
 };
</script>
</fieldset>
<p><button>Publish</button></p>
</form>
```

Features to enable, e.g., inserting links, can be implemented using the [document.execCommand\(\)](#) API, or using [Selection](#) APIs and other DOM APIs.  
[\[EXECCOMMAND\]](#) [\[SELECTION\]](#) [\[DOM\]](#)

The [contenteditable](#) attribute can also be used to great effect:

```
<!doctype html>
<html lang=en>
<title>Live CSS editing!</title>
<style style=white-space:pre contenteditable>
html { margin:.2em; font-size:2em; color:lime; background:purple }
head, title, style { display:block }
body { display:none }
</style>
```

### **element.contentEditable [ = value ]**

Returns "true", "false", or "inherit", based on the state of the [contenteditable](#) attribute.

Can be set, to change that state.

Throws a ["SyntaxError" DOMException](#) if the new value isn't one of those strings.

### **element.isContentEditable**



#### [HTMLElement/isContentEditable](#)

Support in all current engines.

---

Firefox 4+ Safari 3+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 5.5+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.0+ Opera Android 12.1+

Returns true if the element is editable; otherwise, returns false.

The *contentEditable* IDL attribute, on getting, must return the string "true" if the content attribute is set to the true state, "false" if the content attribute is set to the false state, and "inherit" otherwise. On setting, if the new value is an [ASCII case-insensitive](#) match for the string "inherit" then the content attribute must be removed, if the new value is an [ASCII case-insensitive](#) match for the string "true" then the content attribute must be set to the string "true", if the new value is an [ASCII case-insensitive](#) match for the string "false" then the content attribute must be set to the string "false", and otherwise the attribute setter must throw a ["SyntaxError" DOMException](#).

The *isContentEditable* IDL attribute, on getting, must return true if the element is either an [editing host](#) or [editable](#), and false otherwise.

## 6.8.2 Making entire documents editable: the `designMode` getter and setter

`document.designMode [ = value ]`

✓MDN

[Document/designMode](#)

Support in all current engines.

Firefox 1+ Safari 1.2+ Chrome 1+

---

Opera 9+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Returns "on" if the document is editable, and "off" if it isn't.

Can be set, to change the document's current state. This focuses the document and resets the selection in that document.

[Document](#) objects have an associated *design mode enabled*, which is a boolean. It is initially false.

The `designMode` getter steps are to return "on" if `this`'s [design mode enabled](#) is true; otherwise "off".

The `designMode` setter steps are:

1. Let `value` be the given value, [converted to ASCII lowercase](#).
2. If `value` is "on" and `this`'s [design mode enabled](#) is false, then:
  1. Set `this`'s [design mode enabled](#) to true.
  2. Reset `this`'s [active range](#)'s start and end boundary points to be at the start of `this`.
  3. Run the [focusing steps](#) for `this`'s [document element](#), if non-null.
3. If `value` is "off", then set `this`'s [design mode enabled](#) to false.

## 6.8.3 Best practices for in-page editors

Authors are encouraged to set the '[white-space](#)' property on [editing hosts](#) and on markup that was originally created through these editing mechanisms to the value 'pre-wrap'. Default HTML whitespace handling is not well suited to WYSIWYG editing, and line wrapping will not

work correctly in some corner cases if '[white-space](#)' is left at its default value.

As an example of problems that occur if the default 'normal' value is used instead, consider the case of the user typing "yellow  ball", with two spaces (here represented by "  ") between the words. With the editing rules in place for the default value of '[white-space](#)' ('normal'), the resulting markup will either consist of "yellow&nbsp; ball" or "yellow &nbsp;ball"; i.e., there will be a non-breaking space between the two words in addition to the regular space. This is necessary because the 'normal' value for '[white-space](#)' requires adjacent regular spaces to be collapsed together.

In the former case, "yellow" might wrap to the next line ("u" being used here to represent a non-breaking space) even though "yellow" alone might fit at the end of the line; in the latter case, "ball", if wrapped to the start of the line, would have visible indentation from the non-breaking space.

When '[white-space](#)' is set to 'pre-wrap', however, the editing rules will instead simply put two regular spaces between the words, and should the two words be split at the end of a line, the spaces would be neatly removed from the rendering.

#### 6.8.4 Editing APIs

An *editing host* is either an [HTML element](#) with its [contenteditable](#) attribute in the *true* state, or a [child HTML element](#) of a [Document](#) whose [design mode enabled](#) is true.

The definition of the terms [active range](#), [editing host of](#), and [editable](#), the user interface requirements of elements that are [editing hosts](#) or [editable](#), the [execCommand\(\)](#), [queryCommandEnabled\(\)](#), [queryCommandIndeterm\(\)](#), [queryCommandState\(\)](#), [queryCommandSupported\(\)](#), and [queryCommandValue\(\)](#) methods, text selections, and the [delete the selection](#) algorithm are defined in execCommand. [\[EXECCOMMAND\]](#)

#### 6.8.5 Spelling and grammar checking

User agents can support the checking of spelling and grammar of editable text, either in form controls (such as the value of [textarea](#) elements), or in elements in an [editing host](#) (e.g. using [contenteditable](#)).

For each element, user agents must establish a *default behavior*, either through defaults or through preferences expressed by the user. There are three possible default behaviors for each element:

##### *true-by-default*

The element will be checked for spelling and grammar if its contents are editable and spellchecking is not explicitly disabled through the [spellcheck](#) attribute.

##### *false-by-default*

The element will never be checked for spelling and grammar unless spellchecking is

explicitly enabled through the [spellcheck](#) attribute.

### *inherit-by-default*

The element's default behavior is the same as its parent element's. Elements that have no parent element cannot have this as their default behavior.



## [Global\\_attributes/spellcheck](#)

Support in all current engines.

Firefox Yes Safari Yes Chrome 9+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 57+ Safari iOS 9.3+ Chrome Android 47+ WebView Android 47+ Samsung Internet 5.0+ Opera Android 37+

The **spellcheck** attribute is an [enumerated attribute](#) whose keywords are the empty string, **true** and **false**. The empty string and the **true** keyword map to the *true* state. The **false** keyword maps to the *false* state. In addition, there is a third state, the *default* state, which is the [missing value default](#) and the [invalid value default](#).

The *true* state indicates that the element is to have its spelling and grammar checked. The *default* state indicates that the element is to act according to a default behavior, possibly based on the parent element's own [spellcheck](#) state, as defined below. The *false* state indicates that the element is not to be checked.

### **`element.spellcheck [ = value ]`**

Returns true if the element is to have its spelling and grammar checked; otherwise, returns false.

Can be set, to override the default and set the [spellcheck](#) content attribute.

The **spellcheck** IDL attribute, on getting, must return true if the element's [spellcheck](#) content attribute is in the *true* state, or if the element's [spellcheck](#) content attribute is in the *default* state and the element's [default behavior](#) is [true-by-default](#), or if the element's [spellcheck](#) content attribute is in the *default* state and the element's [default behavior](#) is [inherit-by-default](#) and the element's parent element's [spellcheck](#) IDL attribute would return true; otherwise, if none of those conditions applies, then the attribute must instead return false.

The [spellcheck](#) IDL attribute is not affected by user preferences that override the [spellcheck](#) content attribute, and therefore might not reflect the actual spellchecking state.

On setting, if the new value is true, then the element's [spellcheck](#) content attribute must be

set to the literal string "`true`", otherwise it must be set to the literal string "`false`".

---

User agents must only consider the following pieces of text as checkable for the purposes of this feature:

- The `value` of `input` elements whose `type` attributes are in the `Text`, `Search`, `URL`, or `Email` states and that are `mutable` (i.e. that do not have the `readonly` attribute specified and that are not `disabled`).
- The `value` of `textarea` elements that do not have a `readonly` attribute and that are not `disabled`.
- Text in `Text` nodes that are children of `editing hosts` or `editable` elements.
- Text in attributes of `editable` elements.

For text that is part of a `Text` node, the element with which the text is associated is the element that is the immediate parent of the first character of the word, sentence, or other piece of text. For text in attributes, it is the attribute's element. For the values of `input` and `textarea` elements, it is the element itself.

To determine if a word, sentence, or other piece of text in an applicable element (as defined above) is to have spelling- and grammar-checking enabled, the UA must use the following algorithm:

1. If the user has disabled the checking for this text, then the checking is disabled.
2. Otherwise, if the user has forced the checking for this text to always be enabled, then the checking is enabled.
3. Otherwise, if the element with which the text is associated has a `spellcheck` content attribute, then: if that attribute is in the `true` state, then checking is enabled; otherwise, if that attribute is in the `false` state, then checking is disabled.
4. Otherwise, if there is an ancestor element with a `spellcheck` content attribute that is not in the `default` state, then: if the nearest such ancestor's `spellcheck` content attribute is in the `true` state, then checking is enabled; otherwise, checking is disabled.
5. Otherwise, if the element's `default behavior` is `true-by-default`, then checking is enabled.
6. Otherwise, if the element's `default behavior` is `false-by-default`, then checking is disabled.
7. Otherwise, if the element's parent element has *its* checking enabled, then checking is enabled.
8. Otherwise, checking is disabled.

If the checking is enabled for a word/sentence/text, the user agent should indicate spelling and grammar errors in that text. User agents should take into account the other semantics given in the document when suggesting spelling and grammar corrections. User agents may use the language of the element to determine what spelling and grammar rules to use, or may use the user's preferred language settings. UAs should use `input` element attributes such as `pattern` to ensure that the resulting value is valid, where possible.

If checking is disabled, the user agent should not indicate spelling or grammar errors for that

text.

The element with ID "a" in the following example would be the one used to determine if the word "Hello" is checked for spelling errors. In this example, it would not be.

```
<div contenteditable="true">
 Hello!
</div>
```

The element with ID "b" in the following example would have checking enabled (the leading space character in the attribute's value on the [input](#) element causes the attribute to be ignored, so the ancestor's value is used instead, regardless of the default).

```
<p spellcheck="true">
 <label>Name: <input spellcheck=" false" id="b"></label>
</p>
```

This specification does not define the user interface for spelling and grammar checkers. A user agent could offer on-demand checking, could perform continuous checking while the checking is enabled, or could use other interfaces.

#### 6.8.6 Autocapitalization

Some methods of entering text, for example virtual keyboards on mobile devices, and also voice input, often assist users by automatically capitalizing the first letter of sentences (when composing text in a language with this convention). A virtual keyboard that implements autocapitalization might automatically switch to showing uppercase letters (but allow the user to toggle it back to lowercase) when a letter that should be autocapitalized is about to be typed. Other types of input, for example voice input, may perform autocapitalization in a way that does not give users an option to intervene first. The [autocapitalize](#) attribute allows authors to control such behavior.

The [autocapitalize](#) attribute, as typically implemented, does not affect behavior when typing on a physical keyboard. (For this reason, as well as the ability for users to override the autocapitalization behavior in some cases or edit the text after initial input, the attribute must not be relied on for any sort of input validation.)

The [autocapitalize](#) attribute can be used on an [editing host](#) to control autocapitalization behavior for the hosted editable region, on an [input](#) or [textarea](#) element to control the behavior for inputting text into that element, or on a [form](#) element to control the default behavior for all [autocapitalize-inheriting elements](#) associated with the [form](#) element.

The [autocapitalize](#) attribute never causes autocapitalization to be enabled for [input](#) elements whose [type](#) attribute is in one of the [URL](#), [Email](#), or [Password](#) states. (This behavior is included in the [used autocapitalization hint](#) algorithm below.)

The autocapitalization processing model is based on selecting among five *autocapitalization*

*hints*, defined as follows:

#### *default*

The user agent and input method should make their own determination of whether or not to enable autocapitalization.

#### *none*

No autocapitalization should be applied (all letters should default to lowercase).

#### *sentences*

The first letter of each sentence should default to a capital letter; all other letters should default to lowercase.

#### *words*

The first letter of each word should default to a capital letter; all other letters should default to lowercase.

#### *characters*

All letters should default to uppercase.



#### [Global\\_attributes/autocapitalize](#)

Support in all current engines.

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Firefox 83+ Safari No Chrome 43+

---

Opera? Edge 79+

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Edge (Legacy) No Internet Explorer?

---

Firefox Android 83+ Safari iOS 5+ Chrome Android 43+ WebView Android 43+ Samsung Internet 4.0+ Opera Android?

The **autocapitalize** attribute is an [enumerated attribute](#) whose states are the possible [autocapitalization hints](#). The [autocapitalization hint](#) specified by the attribute's state combines with other considerations to form the [used autocapitalization hint](#), which informs the behavior of the user agent. The keywords for this attribute and their state mappings are as follows:

Keyword	State
<i>off</i>	<a href="#">none</a>
<i>none</i>	<a href="#">none</a>
<i>on</i>	<a href="#">sentences</a>

Keyword	State
<i>sentences</i>	
<i>words</i>	<u>words</u>
<i>characters</i>	<u>characters</u>

The [invalid value default](#) is the [sentences](#) state. The [missing value default](#) is the [default](#) state.

### **`element.autocapitalize [ = value ]`**

Returns the current autocapitalization state for the element, or an empty string if it hasn't been set. Note that for [input](#) and [textarea](#) elements that inherit their state from a [form](#) element, this will return the autocapitalization state of the [form](#) element, but for an element in an editable region, this will not return the autocapitalization state of the editing host (unless this element is, in fact, the [editing host](#)).

Can be set, to set the [autocapitalize](#) content attribute (and thereby change the autocapitalization behavior for the element).

To compute the *own autocapitalization hint* of an element *element*, run the following steps:

1. If the [autocapitalize](#) content attribute is present on *element*, and its value is not the empty string, return the state of the attribute.
2. If *element* is an [autocapitalize-inheriting element](#) and has a non-null [form owner](#), return the [own autocapitalization hint](#) of *element's form owner*.
3. Return [default](#).

The [autocapitalize](#) getter steps are to:

1. Let *state* be the [own autocapitalization hint](#) of [this](#).
2. If *state* is [default](#), then return the empty string.
3. If *state* is [none](#), then return "[none](#)".
4. If *state* is [sentences](#), then return "[sentences](#)".
5. Return the keyword value corresponding to *state*.

The [autocapitalize](#) setter steps are to set the [autocapitalize](#) content attribute to the given value.

---

User agents that support customizable autocapitalization behavior for a text input method and wish to allow web developers to control this functionality should, during text input into an element, compute the *used autocapitalization hint* for the element. This will be an

[autocapitalization hint](#) that describes the recommended autocapitalization behavior for text input into the element.

User agents or input methods may choose to ignore or override the [used autocapitalization hint](#) in certain circumstances.

The [used autocapitalization hint](#) for an element *element* is computed using the following algorithm:

1. If *element* is an [input](#) element whose [type](#) attribute is in one of the [URL](#), [Email](#), or [Password](#) states, then return [default](#).
2. If *element* is an [input](#) element or a [textarea](#) element, then return *element*'s [own autocapitalization hint](#).
3. If *element* is an [editing host](#) or an [editable](#) element, then return the [own autocapitalization hint](#) of the [editing host](#) of *element*.
4. Assert: this step is never reached, since text input only occurs in elements that meet one of the above criteria.

#### 6.8.7 Input modalities: the [inputmode](#) attribute

User agents can support the [inputmode](#) attribute on form controls (such as the value of [textarea](#) elements), or in elements in an [editing host](#) (e.g., using [contenteditable](#)).



##### [Global\\_attributes/inputmode](#)

Support in all current engines.

Firefox 23+ Safari No Chrome 66+

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Opera 53+ Edge 79+

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Edge (Legacy) No Internet Explorer No

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Firefox Android 79+ Safari iOS 12.2+ Chrome Android 66+ WebView Android 66+ Samsung Internet 9.0+ Opera Android 47+

The [inputmode](#) content attribute is an [enumerated attribute](#) that specifies what kind of input mechanism would be most helpful for users entering content.

Keyword	Description
<a href="#">none</a>	The user agent should not display a virtual keyboard. This keyword is useful for content that renders its own keyboard control.
<a href="#">text</a>	The user agent should display a virtual keyboard capable of text input in the user's locale.

Keyword	Description
	The user agent should display a virtual keyboard capable of telephone number input.
<i>tel</i>	This should include keys for the digits 0 to 9, the "#" character, and the "*" character. In some locales, this can also include alphabetic mnemonic labels (e.g., in the US, the key labeled "2" is historically also labeled with the letters A, B, and C).
<i>url</i>	The user agent should display a virtual keyboard capable of text input in the user's locale, with keys for aiding in the input of <a href="#">URLs</a> , such as that for the "/" and "." characters and for quick input of strings commonly found in domain names such as "www." or ".com".
<i>email</i>	The user agent should display a virtual keyboard capable of text input in the user's locale, with keys for aiding in the input of email addresses, such as that for the "@" character and the "." character.
<i>numeric</i>	The user agent should display a virtual keyboard capable of numeric input. This keyword is useful for PIN entry.
<i>decimal</i>	The user agent should display a virtual keyboard capable of fractional numeric input. Numeric keys and the format separator for the locale should be shown.
<i>search</i>	The user agent should display a virtual keyboard optimized for search.

The *inputMode* IDL attribute must [reflect](#) the [`inputmode`](#) content attribute, [limited to only known values](#).

When [`inputmode`](#) is unspecified (or is in a state not supported by the user agent), the user agent should determine the default virtual keyboard to be shown. Contextual information such as the input [`type`](#) or [`pattern`](#) attributes should be used to determine which type of virtual keyboard should be presented to the user.

#### 6.8.8 Input modalities: the [`enterkeyhint`](#) attribute

User agents can support the [`enterkeyhint`](#) attribute on form controls (such as the value of [`textarea`](#) elements), or in elements in an [editing host](#) (e.g., using [`contenteditable`](#)).



#### [Global\\_attributes/enterkeyhint](#)

Support in all current engines.

Firefox 94+ | Safari 13.1+ | Chrome 77+

---

Opera 66+ | Edge 79+

---

Edge (Legacy) | No | Internet Explorer | No

---

Firefox Android 94+ | Safari iOS 13.4+ | Chrome Android 77+ | WebView Android 77+ | Samsung Internet 12.0+ | Opera Android 57+

The [`enterkeyhint`](#) content attribute is an [enumerated attribute](#) that specifies what action label (or icon) to present for the enter key on virtual keyboards. This allows authors to

customize the presentation of the enter key in order to make it more helpful for users.

Keyword	Description
<code>enter</code>	The user agent should present a cue for the operation 'enter', typically inserting a new line.
<code>done</code>	The user agent should present a cue for the operation 'done', typically meaning there is nothing more to input and the input method editor (IME) will be closed.
<code>go</code>	The user agent should present a cue for the operation 'go', typically meaning to take the user to the target of the text they typed.
<code>next</code>	The user agent should present a cue for the operation 'next', typically taking the user to the next field that will accept text.
<code>previous</code>	The user agent should present a cue for the operation 'previous', typically taking the user to the previous field that will accept text.
<code>search</code>	The user agent should present a cue for the operation 'search', typically taking the user to the results of searching for the text they have typed.
<code>send</code>	The user agent should present a cue for the operation 'send', typically delivering the text to its target.



## [HTMLElement/enterKeyHint](#)

Support in all current engines.

---

Firefox 94+ Safari 13.1+ Chrome 77+

---

Opera 64+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 94+ Safari iOS 13.4+ Chrome Android 77+ WebView Android 77+ Samsung Internet 12.0+ Opera Android 55+

The `enterKeyHint` IDL attribute must [reflect](#) the `enterkeyhint` content attribute, [limited to only known values](#).

When `enterkeyhint` is unspecified (or is in a state not supported by the user agent), the user agent should determine the default action label (or icon) to present. Contextual information such as the `inputmode`, `type`, or `pattern` attributes should be used to determine which action label (or icon) to present on the virtual keyboard.

## 6.9 Find-in-page

### 6.9.1 Introduction

This section defines *find-in-page* — a common user-agent mechanism which allows users to search through the contents of the page for particular information.

Access to [find-in-page](#) feature is provided via a *find-in-page interface*. This is a user-agent

provided user interface, which allows the user to specify input and the parameters of the search. This interface can appear as a result of a shortcut or a menu selection.

A combination of text input and settings in the [find-in-page interface](#) represents the user *query*. This typically includes the text that the user wants to search for, as well as optional settings (e.g., the ability to restrict the search to whole words only).

The user-agent processes page contents for a given [query](#), and identifies zero or more *matches*, which are content ranges that satisfy the user [query](#).

One of the [matches](#) is identified to the user as the *active match*. It is highlighted and scrolled into view. The user can navigate through the [matches](#) by advancing the [active match](#) using the [find-in-page interface](#).

[Issue #3539](#) tracks standardizing how [find-in-page](#) underlies the currently-unspecified `window.find()` API.

### 6.9.2 Interaction with [details](#)

When find-in-page begins searching for matches, all [details](#) elements in the page which do not have their [open](#) attribute set should have the [skipped contents](#) of their second slot become accessible, without modifying the [open](#) attribute, in order to make find-in-page able to search through it. After find-in-page finishes searching for matches, those [details](#) elements should have their contents become skipped again. This entire process must happen synchronously (and so is not observable to users or to author code). [\[CSSCONTAIN\]](#)

When find-in-page chooses a new [active match](#), perform the following steps:

1. Let *node* be the first node in the [active match](#).
2. [Queue a global task](#) on the [user interaction task source](#) given *node*'s [relevant global object](#) to run the [ancestor details revealing algorithm](#) on *node*.

(This  
is a  
tracking

[vector.\)](#) When find-in-page auto-expands a [details](#) element like this, it will fire a [toggle](#) event. As with the separate [scroll](#) event that find-in-page fires, this event could be used by the page to discover what the user is typing into the find-in-page dialog. If the page creates a tiny scrollable area with the current search term and every possible next character the user could type separated by a gap, and observes which one the browser scrolls to, it can add that character to the search term and update the scrollable area to incrementally build the search term. By wrapping each possible next match in a closed [details](#) element, the page could listen to [toggle](#) events instead of [scroll](#) events. This attack could be addressed for both events by not acting on every character the user types into the find-in-page dialog.

### 6.9.3 Interaction with selection

The find-in-page process is invoked in the context of a document, and may have an effect on the [selection](#) of that document. Specifically, the range that defines the [active match](#) can dictate the current selection. These selection updates, however, can happen at different times during the find-in-page process (e.g. upon the [find-in-page interface](#) dismissal or upon a change in the [active match](#) range).

## 6.10 Drag and drop



### [HTML\\_Drag\\_and\\_Drop\\_API](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 4+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 18 Internet Explorer 5.5+

---

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.5+ Opera Android 14+

This section defines an event-based drag-and-drop mechanism.

This specification does not define exactly what a *drag-and-drop operation* actually is.

On a visual medium with a pointing device, a drag operation could be the default action of a [mousedown](#) event that is followed by a series of [mousemove](#) events, and the drop could be triggered by the mouse being released.

When using an input modality other than a pointing device, users would probably have to explicitly indicate their intention to perform a drag-and-drop operation, stating what they wish to drag and where they wish to drop it, respectively.

However it is implemented, drag-and-drop operations must have a starting point (e.g. where the mouse was clicked, or the start of the selection or element that was selected for the drag), may have any number of intermediate steps (elements that the mouse moves over during a drag, or elements that the user picks as possible drop points as they cycle through possibilities), and must either have an end point (the element above which the mouse button was released, or the element that was finally selected), or be canceled. The end point must be the last element selected as a possible drop point before the drop occurs (so if the operation is not canceled, there must be at least one element in the middle step).

### 6.10.1 Introduction

*This section is non-normative.*

To make an element draggable, give the element a [draggable](#) attribute, and set an event listener for [dragstart](#) that stores the data being dragged.

The event handler typically needs to check that it's not a text selection that is being dragged, and then needs to store data into the [DataTransfer](#) object and set the allowed effects (copy, move, link, or some combination).

For example:

```
<p>What fruits do you like?</p>
<ol ondragstart="dragStartHandler(event)">
 <li draggable="true" data-value="fruit-apple">Apples
 <li draggable="true" data-value="fruit-orange">Oranges
 <li draggable="true" data-value="fruit-pear">Pears

<script>
 var internalDNDType = 'text/x-example'; // set this to something specific to your application
 function dragStartHandler(event) {
 if (event.target instanceof HTMLLIElement) {
 // use the element's data-value="" attribute as the value to be moving
 event.dataTransfer.setData(internalDNDType, event.target.dataset.value)
 event.dataTransfer.effectAllowed = 'move'; // only allow moves
 } else {
 event.preventDefault(); // don't allow selection to be dragged
 }
 }
</script>
```

---

To accept a drop, the drop target has to listen to the following events:

1. The [dragenter](#) event handler reports whether or not the drop target is potentially willing to accept the drop, by canceling the event.
2. The [dragover](#) event handler specifies what feedback will be shown to the user, by setting the [dropEffect](#) attribute of the [DataTransfer](#) associated with the event. This event also needs to be canceled.
3. The [drop](#) event handler has a final chance to accept or reject the drop. If the drop is accepted, the event handler must perform the drop operation on the target. This event needs to be canceled, so that the [dropEffect](#) attribute's value can be used by the source. Otherwise, the drop operation is rejected.

For example:

```
<p>Drop your favorite fruits below:</p>
<ol ondragenter="dragEnterHandler(event)" ondragover="dragOverHandler(event)"
 ondrop="dropHandler(event)">

```

```

<script>
 var internalDNDType = 'text/x-example'; // set this to something specific to your needs
 function dragEnterHandler(event) {
 var items = event.dataTransfer.items;
 for (var i = 0; i < items.length; ++i) {
 var item = items[i];
 if (item.kind == 'string' && item.type == internalDNDType) {
 event.preventDefault();
 return;
 }
 }
 }
 function dragOverHandler(event) {
 event.dataTransfer.dropEffect = 'move';
 event.preventDefault();
 }
 function dropHandler(event) {
 var li = document.createElement('li');
 var data = event.dataTransfer.getData(internalDNDType);
 if (data == 'fruit-apple') {
 li.textContent = 'Apples';
 } else if (data == 'fruit-orange') {
 li.textContent = 'Oranges';
 } else if (data == 'fruit-pear') {
 li.textContent = 'Pears';
 } else {
 li.textContent = 'Unknown Fruit';
 }
 event.target.appendChild(li);
 }
</script>

```

---

To remove the original element (the one that was dragged) from the display, the [dragend](#) event can be used.

For our example here, that means updating the original markup to handle that event:

```

<p>What fruits do you like?</p>
<ol ondragstart="dragStartHandler(event)" ondragend="dragEndHandler(event)">
 ...as before...

<script>
 function dragStartHandler(event) {
 // ...as before...
 }
 function dragEndHandler(event) {

```

```
if (event.dataTransfer.dropEffect == 'move') {
 // remove the dragged element
 event.target.parentNode.removeChild(event.target);
}
</script>
```

### 6.10.2 The drag data store

The data that underlies a drag-and-drop operation, known as the *drag data store*, consists of the following information:

- A *drag data store item list*, which is a list of items representing the dragged data, each consisting of the following information:

#### *The drag data item kind*

The kind of data:

##### *Text*

Text.

##### *File*

Binary data with a filename.

#### *The drag data item type string*

A Unicode string giving the type or format of the data, generally given by a [MIME type](#). Some values that are not [MIME types](#) are special-cased for legacy reasons.

The API does not enforce the use of [MIME types](#); other values can be used as well. In all cases, however, the values are all [converted to ASCII lowercase](#) by the API.

There is a limit of one *text* item per [item type string](#).

#### The actual data

A Unicode or binary string, in some cases with a filename (itself a Unicode string), as per [the drag data item kind](#).

The [drag data store item list](#) is ordered in the order that the items were added to the list; most recently added last.

- The following information, used to generate the UI feedback during the drag:
  - User-agent-defined default feedback information, known as the *drag data store default feedback*.

- Optionally, a bitmap image and the coordinate of a point within that image, known as the *drag data store bitmap* and *drag data store hot spot coordinate*.
- A *drag data store mode*, which is one of the following:

#### *Read/write mode*

For the [dragstart](#) event. New data can be added to the [drag data store](#).

#### *Read-only mode*

For the [drop](#) event. The list of items representing dragged data can be read, including the data. No new data can be added.

#### *Protected mode*

For all other events. The formats and kinds in the [drag data store](#) list of items representing dragged data can be enumerated, but the data itself is unavailable and no new data can be added.

- A *drag data store allowed effects state*, which is a string.

When a [drag data store](#) is *created*, it must be initialized such that its [drag data store item list](#) is empty, it has no [drag data store default feedback](#), it has no [drag data store bitmap](#) and [drag data store hot spot coordinate](#), its [drag data store mode](#) is [protected mode](#), and its [drag data store allowed effects state](#) is the string "[uninitialized](#)".

### 6.10.3 The [DataTransfer](#) interface



#### [DataTransfer](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 3+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 8+

---

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12+

[DataTransfer](#) objects are used to expose the [drag data store](#) that underlies a drag-and-drop operation.

```
[Exposed=Window]
interface DataTransfer {
 constructor();
```

```
attribute DOMString dropEffect;
attribute DOMString effectAllowed;

[SameObject] readonly attribute DataTransferItemList items;
```

undefined setDragImage(Element image, long x, long y);

/\* old interface \*/

```
readonly attribute FrozenArray<DOMString> types;
```

```
DOMString getData(DOMString format);
```

```
undefined setData(DOMString format, DOMString data);
```

```
undefined clearData(optional DOMString format);
```

```
[SameObject] readonly attribute FileList files;
```

```
};
```

**dataTransfer = new DataTransfer()**

✓MDN

## DataTransfer/DataTransfer

Support in all current engines.

Firefox62+Safari14.1+Chrome60+

---

Opera47+Edge79+

---

Edge (Legacy)17+Internet ExplorerNo

---

Firefox Android62+Safari iOS14.5+Chrome Android60+WebView Android60+Samsung Internet8.0+Opera Android44+

Creates a new DataTransfer object with an empty drag data store.

**dataTransfer.dropEffect [ = value ]**

✓MDN

## DataTransfer/dropEffect

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer8+

---

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns the kind of operation that is currently selected. If the kind of operation isn't one of those that is allowed by the effectAllowed attribute, then the operation will fail.

Can be set, to change the selected operation.

The possible values are "[none](#)", "[copy](#)", "[link](#)", and "[move](#)".

### **`dataTransfer.effectAllowed [ = value ]`**

✓MDN

#### [DataTransfer/effectAllowed](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 3+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 8+

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the kinds of operations that are to be allowed.

Can be set (during the [dragstart](#) event), to change the allowed operations.

The possible values are "[none](#)", "[copy](#)", "[copyLink](#)", "[copyMove](#)", "[link](#)", "[linkMove](#)", "[move](#)", "[all](#)", and "[uninitialized](#)",

### **`dataTransfer.items`**

✓MDN

#### [DataTransfer/items](#)

Support in all current engines.

Firefox 50+ Safari 11.1+ Chrome 4+

Opera 12+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 52+ Safari iOS 11.3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12+

Returns a [DataTransferItemList](#) object, with the drag data.

### **`dataTransfer.setDragImage(element, x, y)`**

✓MDN

#### [DataTransfer/setDragImage](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)18Internet ExplorerNo

---

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Uses the given element to update the drag feedback, replacing any previously specified feedback.

### ***dataTransfer.types***

✓MDN

[DataTransfer/types](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns a [frozen array](#) listing the formats that were set in the [dragstart](#) event. In addition, if any files are being dragged, then one of the types will be the string "Files".

### ***data = dataTransfer.getData(format)***

✓MDN

[DataTransfer/getData](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer8+

---

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

Returns the specified data. If there is no such data, returns the empty string.

### ***dataTransfer.setData(format, data)***

✓MDN

[DataTransfer/setData](#)

Support in all current engines.

Firefox 10+ Safari 5+ Chrome 3+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 8+

---

Firefox Android 10+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12+

Adds the specified data.

### **`dataTransfer.clearData([ format ])`**

✓MDN

[DataTransfer/clearData](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 3+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 8+

---

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Removes the data of the specified formats. Removes all data if the argument is omitted.

### **`dataTransfer.files`**

✓MDN

[DataTransfer/files](#)

Support in all current engines.

Firefox 3.6+ Safari 4+ Chrome 3+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns a [FileList](#) of the files being dragged, if any.

[DataTransfer](#) objects that are created as part of [drag-and-drop events](#) are only valid while those events are being fired.

A [DataTransfer](#) object is associated with a [drag data store](#) while it is valid.

A [DataTransfer](#) object has an associated *types array*, which is a

`FrozenArray<DOMString>`, initially empty. When the contents of the `DataTransfer` object's `drag data store item list` change, or when the `DataTransfer` object becomes no longer associated with a `drag data store`, run the following steps:

1. Let  $L$  be an empty sequence.
2. If the `DataTransfer` object is still associated with a `drag data store`, then:
  1. For each item in the `DataTransfer` object's `drag data store item list` whose `kind` is `text`, add an entry to  $L$  consisting of the item's `type string`.
  2. If there are any items in the `DataTransfer` object's `drag data store item list` whose `kind` is `File`, then add an entry to  $L$  consisting of the string "`Files`". (This value can be distinguished from the other values because it is not lowercase.)
3. Set the `DataTransfer` object's `types array` to the result of [creating a frozen array](#) from  $L$ .

The `DataTransfer()` constructor, when invoked, must return a newly created `DataTransfer` object initialized as follows:

1. Set the `drag data store`'s `item list` to be an empty list.
2. Set the `drag data store`'s `mode` to [read/write mode](#).
3. Set the `dropEffect` and `effectAllowed` to "`none`".

The `dropEffect` attribute controls the drag-and-drop feedback that the user is given during a drag-and-drop operation. When the `DataTransfer` object is created, the `dropEffect` attribute is set to a string value. On getting, it must return its current value. On setting, if the new value is one of "`none`", "`copy`", "`link`", or "`move`", then the attribute's current value must be set to the new value. Other values must be ignored.

The `effectAllowed` attribute is used in the drag-and-drop processing model to initialize the `dropEffect` attribute during the `dragenter` and `dragover` events. When the `DataTransfer` object is created, the `effectAllowed` attribute is set to a string value. On getting, it must return its current value. On setting, if `drag data store`'s `mode` is the [read/write mode](#) and the new value is one of "`none`", "`copy`", "`copyLink`", "`copyMove`", "`link`", "`linkMove`", "`move`", "`all`", or "`uninitialized`", then the attribute's current value must be set to the new value. Otherwise it must be left unchanged.

The `items` attribute must return a `DataTransferItemList` object associated with the `DataTransfer` object.

The `setDragImage(image, x, y)` method must run the following steps:

1. If the `DataTransfer` object is no longer associated with a `drag data store`, return.

Nothing happens.

2. If the [drag data store](#)'s [mode](#) is not the [read/write mode](#), return. Nothing happens.
3. If *image* is an [img](#) element, then set the [drag data store bitmap](#) to the element's image (at its [intrinsic size](#)); otherwise, set the [drag data store bitmap](#) to an image generated from the given element (the exact mechanism for doing so is not currently specified).
4. Set the [drag data store hot spot coordinate](#) to the given x, y coordinate.

The *types* attribute must return this [DataTransfer](#) object's [types array](#).

The [getData\(format\)](#) method must run the following steps:

1. If the [DataTransfer](#) object is no longer associated with a [drag data store](#), then return the empty string.
2. If the [drag data store](#)'s [mode](#) is the [protected mode](#), then return the empty string.
3. Let *format* be the first argument, [converted to ASCII lowercase](#).
4. Let *convert-to-URL* be false.
5. If *format* equals "text", change it to "text/plain".
6. If *format* equals "url", change it to "text/uri-list" and set *convert-to-URL* to true.
7. If there is no item in the [drag data store item list](#) whose [kind](#) is *text* and whose [type string](#) is equal to *format*, return the empty string.
8. Let *result* be the data of the item in the [drag data store item list](#) whose [kind](#) is *Plain Unicode string* and whose [type string](#) is equal to *format*.
9. If *convert-to-URL* is true, then parse *result* as appropriate for [text/uri-list](#) data, and then set *result* to the first URL from the list, if any, or the empty string otherwise.  
[\[RFC2483\]](#)
10. Return *result*.

The [setData\(format, data\)](#) method must run the following steps:

1. If the [DataTransfer](#) object is no longer associated with a [drag data store](#), return. Nothing happens.
2. If the [drag data store](#)'s [mode](#) is not the [read/write mode](#), return. Nothing happens.
3. Let *format* be the first argument, [converted to ASCII lowercase](#).

4. If *format* equals "text", change it to "text/plain".  
If *format* equals "url", change it to "text/uri-list".
5. Remove the item in the [drag data store item list](#) whose [kind](#) is *text* and whose [type string](#) is equal to *format*, if there is one.
6. Add an item to the [drag data store item list](#) whose [kind](#) is *text*, whose [type string](#) is equal to *format*, and whose data is the string given by the method's second argument.

The [clearData\(\*format\*\)](#) method must run the following steps:

1. If the [DataTransfer](#) object is no longer associated with a [drag data store](#), return.  
Nothing happens.
2. If the [drag data store](#)'s [mode](#) is not the [read/write mode](#), return. Nothing happens.
3. If the method was called with no arguments, remove each item in the [drag data store item list](#) whose [kind](#) is *Plain Unicode string*, and return.
4. Set *format* to *format*, [converted to ASCII lowercase](#).
5. If *format* equals "text", change it to "text/plain".  
If *format* equals "url", change it to "text/uri-list".
6. Remove the item in the [drag data store item list](#) whose [kind](#) is *text* and whose [type string](#) is equal to *format*, if there is one.

The [clearData\(\)](#) method does not affect whether any files were included in the drag, so the [types](#) attribute's list might still not be empty after calling [clearData\(\)](#) (it would still contain the "Files" string if any files were included in the drag).

The [files](#) attribute must return a [live FileList](#) sequence consisting of [File](#) objects representing the files found by the following steps. Furthermore, for a given [FileList](#) object and a given underlying file, the same [File](#) object must be used each time.

1. Start with an empty list *L*.
2. If the [DataTransfer](#) object is no longer associated with a [drag data store](#), the [FileList](#) is empty. Return the empty list *L*.
3. If the [drag data store](#)'s [mode](#) is the [protected mode](#), Return the empty list *L*.
4. For each item in the [drag data store item list](#) whose [kind](#) is *File*, add the item's data (the file, in particular its name and contents, as well as its [type](#)) to the list *L*.
5. The files found by these steps are those in the list *L*.

This version of the API does not expose the types of the files during the drag.

#### 6.10.3.1 The [DataTransferItemList](#) interface



##### [DataTransferItemList](#)

Support in all current engines.

Firefox50+Safari6+Chrome13+

Opera12+Edge79+

Edge (Legacy)12+Internet ExplorerNo

Firefox Android50+Safari iOS6+Chrome Android18+WebView Android4.4+Samsung Internet1.0+Opera AndroidNo

Each [DataTransfer](#) object is associated with a [DataTransferItemList](#) object.

[Exposed=Window]

```
interface DataTransferItemList {
 readonly attribute unsigned long length;
 getter DataTransferItem (unsigned long index);
 DataTransferItem? add(DOMString data, DOMString type);
 DataTransferItem? add(File data);
 undefined remove(unsigned long index);
 undefined clear();
};
```

##### **[items.length](#)**



##### [DataTransferItemList/length](#)

Support in all current engines.

Firefox50+Safari6+Chrome13+

Opera12+Edge79+

Edge (Legacy)12+Internet ExplorerNo

Firefox Android50+Safari iOS6+Chrome Android18+WebView Android4.4+Samsung Internet1.0+Opera AndroidNo

Returns the number of items in the [drag data store](#).

##### **[items\[index\]](#)**

Returns the [DataTransferItem](#) object representing the *index*th entry in the [drag data](#)

[store](#).

## ***items.remove(index)***

✓MDN

### [DataTransferItemList/remove](#)

Support in all current engines.

Firefox50+Safari6+Chrome31+

Opera12+Edge79+

Edge (Legacy)12+Internet ExplorerNo

Firefox Android50+Safari iOS6+Chrome Android31+WebView Android4.4.3+Samsung Internet2.0+Opera AndroidNo

Removes the *index*th entry in the [drag data store](#).

## ***items.clear()***

✓MDN

### [DataTransferItemList/clear](#)

Support in all current engines.

Firefox50+Safari6+Chrome13+

Opera12+Edge79+

Edge (Legacy)12+Internet ExplorerNo

Firefox Android50+Safari iOS6+Chrome Android18+WebView Android4.4+Samsung Internet1.0+Opera AndroidNo

Removes all the entries in the [drag data store](#).

## ***items.add(data)***

✓MDN

### [DataTransferItemList/add](#)

Support in all current engines.

Firefox 50+ Safari 6+ Chrome 13+

Opera 12+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 50+ Safari iOS 6+ Chrome Android 18+ WebView Android 4.4+ Samsung

Internet 1.0+ Opera Android No

## ***items.add(data, type)***

Adds a new entry for the given data to the [drag data store](#). If the data is plain text then a *type* string has to be provided also.

While the [DataTransferItemList](#) object's [DataTransfer](#) object is associated with a [drag data store](#), the [DataTransferItemList](#) object's *mode* is the same as the [drag data store mode](#). When the [DataTransferItemList](#) object's [DataTransfer](#) object is *not* associated with a [drag data store](#), the [DataTransferItemList](#) object's *mode* is the *disabled mode*. The [drag data store](#) referenced in this section (which is used only when the [DataTransferItemList](#) object is not in the *disabled mode*) is the [drag data store](#) with which the [DataTransferItemList](#) object's [DataTransfer](#) object is associated.

The *length* attribute must return zero if the object is in the *disabled mode*; otherwise it must return the number of items in the [drag data store item list](#).

When a [DataTransferItemList](#) object is not in the *disabled mode*, its [supported property indices](#) are the [indices](#) of the [drag data store item list](#).

To [determine the value of an indexed property \*i\*](#) of a [DataTransferItemList](#) object, the user agent must return a [DataTransferItem](#) object representing the *i*th item in the [drag data store](#). The same object must be returned each time a particular item is obtained from this [DataTransferItemList](#) object. The [DataTransferItem](#) object must be associated with the same [DataTransfer](#) object as the [DataTransferItemList](#) object when it is first created.

The *add()* method must run the following steps:

1. If the [DataTransferItemList](#) object is not in the [read/write mode](#), return null.
2. Jump to the appropriate set of steps from the following list:

If the first argument to the method is a string

If there is already an item in the [drag data store item list](#) whose [kind](#) is *text* and whose [type string](#) is equal to the value of the method's second argument, [converted to ASCII lowercase](#), then throw a "[NotSupportedError](#)" [DOMException](#).

Otherwise, add an item to the [drag data store item list](#) whose [kind](#) is *text*, whose [type string](#) is equal to the value of the method's second argument, [converted to ASCII lowercase](#), and whose data is the string given by the method's first argument.

If the first argument to the method is a [File](#)

Add an item to the [drag data store item list](#) whose [kind](#) is *File*, whose [type string](#) is the [type](#) of the [File](#), [converted to ASCII lowercase](#), and whose data is the same as the [File](#)'s data.

3. [Determine the value of the indexed property](#) corresponding to the newly added item, and return that value (a newly created [DataTransferItem](#) object).

The [remove\(index\)](#) method must run these steps:

1. If the [DataTransferItemList](#) object is not in the [read/write mode](#), throw an "[InvalidStateError](#)" [DOMException](#).
2. Remove the *index*th item from the [drag data store](#).

The [clear\(\)](#) method, if the [DataTransferItemList](#) object is in the [read/write mode](#), must remove all the items from the [drag data store](#). Otherwise, it must do nothing.

#### 6.10.3.2 The [DataTransferItem](#) interface



##### [DataTransferItem](#)

Support in all current engines.

Firefox 50+ Safari 5.1+ Chrome 11+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 50+ Safari iOS 5+ Chrome Android 18+ WebView Android 4+ Samsung Internet 1.0+ Opera Android No

Each [DataTransferItem](#) object is associated with a [DataTransfer](#) object.

[Exposed=Window]

```
interface DataTransferItem {
 readonly attribute DOMString kind;
 readonly attribute DOMString type;
 undefined getAsString\(FunctionStringCallback? _callback\);
 File? getAsFile\(\);
};

callback FunctionStringCallback = undefined (DOMString data);
```

### ***item.kind***

✓MDN

[DataTransferItem/kind](#)

Support in all current engines.

---

Firefox 50+ Safari 5.1+ Chrome 11+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 50+ Safari iOS 5+ Chrome Android 18+ WebView Android 4+ Samsung Internet 1.0+ Opera Android No

Returns [the drag data item kind](#), one of: "string", "file".

### ***item.type***

✓MDN

[DataTransferItem/type](#)

Support in all current engines.

---

Firefox 50+ Safari 5.1+ Chrome 11+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 50+ Safari iOS 5+ Chrome Android 18+ WebView Android 4+ Samsung Internet 1.0+ Opera Android No

Returns [the drag data item type string](#).

### ***item.getAsString(callback)***

✓MDN

[DataTransferItem/getAsString](#)

Support in all current engines.

Firefox50+Safari5.1+Chrome11+

---

Opera12+Edge79+

---

Edge (Legacy)12+Internet ExplorerNo

---

Firefox Android50+Safari iOS5+Chrome Android18+WebView Android4+Samsung Internet1.0+Opera AndroidNo

Invokes the callback with the string data as the argument, if [the drag data item kind](#) is *text*.

**file = item.getAsFile()**

✓MDN

[DataTransferItem/getAsFile](#)

Support in all current engines.

Firefox50+Safari5.1+Chrome11+

---

Opera12+Edge79+

---

Edge (Legacy)12+Internet ExplorerNo

---

Firefox Android50+Safari iOS5+Chrome Android18+WebView Android4+Samsung Internet1.0+Opera AndroidNo

Returns a [File](#) object, if [the drag data item kind](#) is *File*.

While the [DataTransferItem](#) object's [DataTransfer](#) object is associated with a [drag data store](#) and that [drag data store](#)'s [drag data store item list](#) still contains the item that the [DataTransferItem](#) object represents, the [DataTransferItem](#) object's *mode* is the same as the [drag data store mode](#). When the [DataTransferItem](#) object's [DataTransfer](#) object is *not* associated with a [drag data store](#), or if the item that the [DataTransferItem](#) object represents has been removed from the relevant [drag data store item list](#), the [DataTransferItem](#) object's *mode* is the *disabled mode*. The [drag data store](#) referenced in this section (which is used only when the [DataTransferItem](#) object is not in the *disabled mode*) is the [drag data store](#) with which the [DataTransferItem](#) object's [DataTransfer](#) object is associated.

The *kind* attribute must return the empty string if the [DataTransferItem](#) object is in the *disabled mode*; otherwise it must return the string given in the cell from the second column of the following table from the row whose cell in the first column contains [the drag data item kind](#) of the item represented by the [DataTransferItem](#) object:

Kind String

*Text*"string"

*File* "file"

The *type* attribute must return the empty string if the [DataTransferItem](#) object is in the

*disabled mode*; otherwise it must return [the drag data item type string](#) of the item represented by the [DataTransferItem](#) object.

The `getAsString(callback)` method must run the following steps:

1. If the `callback` is null, return.
2. If the [DataTransferItem](#) object is not in the [read/write mode](#) or the [read-only mode](#), return. The callback is never invoked.
3. If [the drag data item kind](#) is not `text`, then return. The callback is never invoked.
4. Otherwise, [queue a task](#) to invoke `callback`, passing the actual data of the item represented by the [DataTransferItem](#) object as the argument.

The `getAsFile()` method must run the following steps:

1. If the [DataTransferItem](#) object is not in the [read/write mode](#) or the [read-only mode](#), then return null.
2. If [the drag data item kind](#) is not `File`, then return null.
3. Return a new [File](#) object representing the actual data of the item represented by the [DataTransferItem](#) object.

#### 6.10.4 The [DragEvent](#) interface



##### [DragEvent/DragEvent](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 46+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android Yes Safari iOS No Chrome Android No WebView Android No Samsung Internet No Opera Android No

##### [DragEvent](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 3+

---

Opera 12+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android4+Safari iOSNoChrome AndroidNoWebView AndroidNoSamsung InternetNoOpera AndroidNo

The drag-and-drop processing model involves several events. They all use the [DragEvent](#) interface.

```
[Exposed=Window]
interface DragEvent : MouseEvent {
 constructor(DOMString type, optional DragEventInit eventInitDict = {});

 readonly attribute DataTransfer? dataTransfer;
};

dictionary DragEventInit : MouseEventInit {
 DataTransfer? dataTransfer = null;
};

event.dataTransfer
```

✓MDN

## [DragEvent/dataTransfer](#)

Support in all current engines.

---

Firefox3.5+Safari3.1+Chrome46+

---

OperaYesEdge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox AndroidYesSafari iOSNoChrome AndroidNoWebView AndroidNoSamsung

InternetNoOpera AndroidNo

Returns the [DataTransfer](#) object for the event.

Although, for consistency with other event interfaces, the [DragEvent](#) interface has a constructor, it is not particularly useful. In particular, there's no way to create a useful [DataTransfer](#) object from script, as [DataTransfer](#) objects have a processing and security model that is coordinated by the browser during drag-and-drops.

The *dataTransfer* attribute of the [DragEvent](#) interface must return the value it was initialized to. It represents the context information for the event.

When a user agent is required to *fire a DND event* named *e* at an element, using a particular [drag data store](#), and optionally with a specific *related target*, the user agent must run the following steps:

1. Let *dataDragStoreWasChanged* be false.
2. If no specific *related target* was provided, set *related target* to null.

3. Let `window` be the [relevant global object](#) of the [Document](#) object of the specified target element.
4. If `e` is [dragstart](#), then set the [drag data store mode](#) to the [read/write mode](#) and set `dataDragStoreWasChanged` to true.  
If `e` is [drop](#), set the [drag data store mode](#) to the [read-only mode](#).
5. Let `dataTransfer` be a newly created [DataTransfer](#) object associated with the given [drag data store](#).
6. Set the [effectAllowed](#) attribute to the [drag data store's drag data store allowed effects state](#).
7. Set the [dropEffect](#) attribute to "[none](#)" if `e` is [dragstart](#), [drag](#), or [dragleave](#); to the value corresponding to the [current drag operation](#) if `e` is [drop](#) or [dragend](#); and to a value based on the [effectAllowed](#) attribute's value and the drag-and-drop source, as given by the following table, otherwise (i.e. if `e` is [dragenter](#) or [dragover](#)):

<a href="#">effectAllowed</a>	<a href="#">dropEffect</a>
<a href="#">"none"</a>	<a href="#">"none"</a>
<a href="#">"copy"</a>	<a href="#">"copy"</a>
<a href="#">"copyLink"</a>	<a href="#">"copy"</a> , or, <a href="#">if appropriate</a> , <a href="#">"link"</a>
<a href="#">"copyMove"</a>	<a href="#">"copy"</a> , or, <a href="#">if appropriate</a> , <a href="#">"move"</a>
<a href="#">"all"</a>	<a href="#">"copy"</a> , or, <a href="#">if appropriate</a> , either <a href="#">"link"</a> or <a href="#">"move"</a>
<a href="#">"link"</a>	<a href="#">"link"</a>
<a href="#">"linkMove"</a>	<a href="#">"link"</a> , or, <a href="#">if appropriate</a> , <a href="#">"move"</a>
<a href="#">"move"</a>	<a href="#">"move"</a>
<a href="#">"uninitialized"</a> when what is being dragged is a selection from a text control	<a href="#">"move"</a> , or, <a href="#">if appropriate</a> , either <a href="#">"copy"</a> or <a href="#">"link"</a>
<a href="#">"uninitialized"</a> when what is being dragged is a selection	<a href="#">"copy"</a> , or, <a href="#">if appropriate</a> , either <a href="#">"link"</a> or <a href="#">"move"</a>
<a href="#">"uninitialized"</a> when what is being dragged is an <a href="#">a</a> <a href="#">"link"</a> , or, <a href="#">if appropriate</a> , either <a href="#">"copy"</a> or <a href="#">"move"</a>	<a href="#">"copy"</a> , or, <a href="#">if appropriate</a> , either <a href="#">"link"</a> or <a href="#">"move"</a>
Any other case	

Where the table above provides *possibly appropriate alternatives*, user agents may instead use the listed alternative values if platform conventions dictate that the user has requested those alternate effects.

For example, Windows platform conventions are such that dragging while holding the "alt" key indicates a preference for linking the data, rather than moving or copying it. Therefore, on a Windows system, if "[link](#)" is an option according to the table above while the "alt" key is depressed, the user agent could select that instead of "[copy](#)" or "[move](#)".

8. Let *event* be the result of [creating an event](#) using [DragEvent](#).
9. Initialize *event*'s [type](#) attribute to *e*, its [bubbles](#) attribute to true, its [view](#) attribute to *window*, its [relatedTarget](#) attribute to *related target*, and its [dataTransfer](#) attribute to *dataTransfer*.
10. If *e* is not [dragleave](#) or [dragend](#), then initialize *event*'s [cancelable](#) attribute to true.
11. Initialize *event*'s mouse and key attributes initialized according to the state of the input devices as they would be for user interaction events.

If there is no relevant pointing device, then initialize *event*'s [screenX](#), [screenY](#), [clientX](#), [clientY](#), and [button](#) attributes to 0.
12. [Dispatch](#) *event* at the specified target element.
13. Set the [drag data store allowed effects state](#) to the current value of *dataTransfer*'s [effectAllowed](#) attribute. (It can only have changed value if *e* is [dragstart](#).)
14. If *dataDragStoreWasChanged* is true, then set the [drag data store mode](#) back to the [protected mode](#).
15. Break the association between *dataTransfer* and the [drag data store](#).

#### 6.10.5 Processing model

When the user attempts to begin a drag operation, the user agent must run the following steps. User agents must act as if these steps were run even if the drag actually started in another document or application and the user agent was not aware that the drag was occurring until it intersected with a document under the user agent's purview.

1. Determine what is being dragged, as follows:

If the drag operation was invoked on a selection, then it is the selection that is being dragged.

Otherwise, if the drag operation was invoked on a [Document](#), it is the first element, going up the ancestor chain, starting at the node that the user tried to drag, that has the IDL attribute [draggable](#) set to true. If there is no such element, then nothing is being dragged; return, the drag-and-drop operation is never started.

Otherwise, the drag operation was invoked outside the user agent's purview. What is being dragged is defined by the document or application where the drag was started.

[img](#) elements and [a](#) elements with an [href](#) attribute have their [draggable](#) attribute set to true by default.

2. [Create a drag data store](#). All the DND events fired subsequently by the steps in this section must use this [drag data store](#).
3. Establish which DOM node is the *source node*, as follows:

If it is a selection that is being dragged, then the [source node](#) is the [Text](#) node that the user started the drag on (typically the [Text](#) node that the user originally clicked). If the user did not specify a particular node, for example if the user just told the user agent to begin a drag of "the selection", then the [source node](#) is the first [Text](#) node containing a part of the selection.

Otherwise, if it is an element that is being dragged, then the [source node](#) is the element that is being dragged.

Otherwise, the [source node](#) is part of another document or application. When this specification requires that an event be dispatched at the [source node](#) in this case, the user agent must instead follow the platform-specific conventions relevant to that situation.

Multiple events are fired on the [source node](#) during the course of the drag-and-drop operation.

4. Determine the *list of dragged nodes*, as follows:

If it is a selection that is being dragged, then the [list of dragged nodes](#) contains, in [tree order](#), every node that is partially or completely included in the selection (including all their ancestors).

Otherwise, the [list of dragged nodes](#) contains only the [source node](#), if any.

5. If it is a selection that is being dragged, then add an item to the [drag data store item list](#), with its properties set as follows:

[The drag data item type string](#)  
["text/plain"](#)

[The drag data item kind](#)  
[Text](#)

[The actual data](#)  
The text of the selection

Otherwise, if any files are being dragged, then add one item per file to the [drag data store item list](#), with their properties set as follows:

#### [The drag data item type string](#)

The MIME type of the file, if known, or "[application/octet-stream](#)" otherwise.

#### [The drag data item kind](#)

*File*

#### [The actual data](#)

The file's contents and name.

Dragging files can currently only happen from outside a [browsing context](#), for example from a file system manager application.

If the drag initiated outside of the application, the user agent must add items to the [drag data store item list](#) as appropriate for the data being dragged, honoring platform conventions where appropriate; however, if the platform conventions do not use [MIME types](#) to label dragged data, the user agent must make a best-effort attempt to map the types to MIME types, and, in any case, all the [drag data item type strings](#) must be [converted to ASCII lowercase](#).

User agents may also add one or more items representing the selection or dragged element(s) in other forms, e.g. as HTML.

6. If the [list of dragged nodes](#) is not empty, then [extract the microdata from those nodes into a JSON form](#), and add one item to the [drag data store item list](#), with its properties set as follows:

#### [The drag data item type string](#)

[application/microdata+json](#)

#### [The drag data item kind](#)

*Text*

#### [The actual data](#)

The resulting JSON string.

7. Run the following substeps:

1. Let *urls* be an empty list of [absolute URLs](#).
2. For each *node* in the [list of dragged nodes](#):

If the node is an **a** element with an [href](#) attribute

Add to *urls* the result of [parsing](#) the element's [href](#) content attribute relative to the element's [node document](#).

If the node is an `img` element with a `src` attribute

Add to `urls` the result of [parsing](#) the element's `src` content attribute relative to the element's [node document](#).

3. If `urls` is still empty, then return.
4. Let `url string` be the result of concatenating the strings in `urls`, in the order they were added, separated by a U+000D CARRIAGE RETURN U+000A LINE FEED character pair (CRLF).
5. Add one item to the [drag data store item list](#), with its properties set as follows:

[The drag data item type string](#)  
[text/uri-list](#)

[The drag data item kind](#)  
Text

The actual data  
`url string`

8. Update the [drag data store default feedback](#) as appropriate for the user agent (if the user is dragging the selection, then the selection would likely be the basis for this feedback; if the user is dragging an element, then that element's rendering would be used; if the drag began outside the user agent, then the platform conventions for determining the drag feedback should be used).
9. [Fire a DND event](#) named `dragstart` at the [source node](#).

If the event is canceled, then the drag-and-drop operation should not occur; return.

Since events with no event listeners registered are, almost by definition, never canceled, drag-and-drop is always available to the user if the author does not specifically prevent it.

10. [Fire a pointer event](#) at the [source node](#) named `pointercancel`, and fire any other follow-up events as required by *Pointer Events*. [\[POINTEREVENTS\]](#)
11. [Initiate the drag-and-drop operation](#) in a manner consistent with platform conventions, and as described below.

The drag-and-drop feedback must be generated from the first of the following sources that is available:

1. The [drag data store bitmap](#), if any. In this case, the [drag data store hot spot coordinate](#) should be used as hints for where to put the cursor relative to the resulting image. The values are expressed as distances in [CSS pixels](#) from the left side and from the top side of the image respectively. [\[CSS\]](#)

## 2. The [drag data store default feedback](#).

From the moment that the user agent is to *initiate the drag-and-drop operation*, until the end of the drag-and-drop operation, device input events (e.g. mouse and keyboard events) must be suppressed.

During the drag operation, the element directly indicated by the user as the drop target is called the *immediate user selection*. (Only elements can be selected by the user; other nodes must not be made available as drop targets.) However, the [immediate user selection](#) is not necessarily the *current target element*, which is the element currently selected for the drop part of the drag-and-drop operation.

The [immediate user selection](#) changes as the user selects different elements (either by pointing at them with a pointing device, or by selecting them in some other way). The [current target element](#) changes when the [immediate user selection](#) changes, based on the results of event listeners in the document, as described below.

Both the [current target element](#) and the [immediate user selection](#) can be null, which means no target element is selected. They can also both be elements in other (DOM-based) documents, or other (non-web) programs altogether. (For example, a user could drag text to a word-processor.) The [current target element](#) is initially null.

In addition, there is also a *current drag operation*, which can take on the values "[none](#)", "[copy](#)", "[link](#)", and "[move](#)". Initially, it has the value "[none](#)". It is updated by the user agent as described in the steps below.

User agents must, as soon as the drag operation is [initiated](#) and every 350ms ( $\pm 200\text{ms}$ ) thereafter for as long as the drag operation is ongoing, [queue a task](#) to perform the following steps in sequence:

1. If the user agent is still performing the previous iteration of the sequence (if any) when the next iteration becomes due, return for this iteration (effectively "skipping missed frames" of the drag-and-drop operation).
2. [Fire a DND event](#) named [drag](#) at the [source node](#). If this event is canceled, the user agent must set the [current drag operation](#) to "[none](#)" (no drag operation).
3. If the [drag](#) event was not canceled and the user has not ended the drag-and-drop operation, check the state of the drag-and-drop operation, as follows:
  1. If the user is indicating a different [immediate user selection](#) than during the last iteration (or if this is the first iteration), and if this [immediate user selection](#) is not the same as the [current target element](#), then update the [current target element](#) as follows:

If the new [immediate user selection](#) is null

Set the [current target element](#) to null also.

If the new [immediate user selection](#) is in a non-DOM document or application

Set the [current target element](#) to the [immediate user selection](#).

Otherwise

[Fire a DND event](#) named [dragenter](#) at the [immediate user selection](#).

If the event is canceled, then set the [current target element](#) to the [immediate user selection](#).

Otherwise, run the appropriate step from the following list:

If the [immediate user selection](#) is a text control (e.g., [textarea](#), or an [input](#) element whose [type](#) attribute is in the [Text](#) state) or an [editing host](#) or [editable](#) element, and the [drag data store item list](#) has an item with the [drag data item type string "text/plain"](#) and [the drag data item kind text](#)

Set the [current target element](#) to the [immediate user selection](#) anyway.

If the [immediate user selection](#) is [the body element](#)

Leave the [current target element](#) unchanged.

Otherwise

[Fire a DND event](#) named [dragenter](#) at [the body element](#), if there is one, or at the [Document](#) object, if not. Then, set the [current target element](#) to [the body element](#), regardless of whether that event was canceled or not.

2. If the previous step caused the [current target element](#) to change, and if the previous target element was not null or a part of a non-DOM document, then [fire a DND event](#) named [dragleave](#) at the previous target element, with the new [current target element](#) as the specific *related target*.
3. If the [current target element](#) is a DOM element, then [fire a DND event](#) named [dragover](#) at this [current target element](#).

If the [dragover](#) event is not canceled, run the appropriate step from the following list:

If the [current target element](#) is a text control (e.g., [textarea](#), or an [input](#) element whose [type](#) attribute is in the [Text](#) state) or an [editing host](#) or [editable](#) element, and the [drag data store item list](#) has an item with [the drag data item type string "text/plain"](#) and [the drag data item kind text](#)

Set the [current drag operation](#) to either "[copy](#)" or "[move](#)", as appropriate given the platform conventions.

Otherwise

Reset the [current drag operation](#) to "[none](#)".

Otherwise (if the [dragover](#) event is canceled), set the [current drag operation](#) based on the values of the [effectAllowed](#) and [dropEffect](#) attributes of the [DragEvent](#) object's [dataTransfer](#) object as they stood after the event [dispatch](#) finished, as per the following table:

<a href="#">effectAllowed</a>	<a href="#">dropEffect</a>	Drag operation
<a href="#">"uninitialized", "copy", "copyLink", "copyMove", or "all"</a>	<a href="#">"copy"</a>	<a href="#">"copy"</a>
<a href="#">"uninitialized", "link", "copyLink", "linkMove", or "all"</a>	<a href="#">"link"</a>	<a href="#">"link"</a>
<a href="#">"uninitialized", "move", "copyMove", "linkMove", or "all"</a>	<a href="#">"move"</a>	<a href="#">"move"</a>
Any other case		<a href="#">"none"</a>

4. Otherwise, if the [current target element](#) is not a DOM element, use platform-specific mechanisms to determine what drag operation is being performed (none, copy, link, or move), and set the [current drag operation](#) accordingly.
5. Update the drag feedback (e.g. the mouse cursor) to match the [current drag operation](#), as follows:

Drag operation	Feedback
<a href="#">"copy"</a>	Data will be copied if dropped here.
<a href="#">"link"</a>	Data will be linked if dropped here.
<a href="#">"move"</a>	Data will be moved if dropped here.
<a href="#">"none"</a>	No operation allowed, dropping here will cancel the drag-and-drop operation.

4. Otherwise, if the user ended the drag-and-drop operation (e.g. by releasing the mouse button in a mouse-driven drag-and-drop interface), or if the [drag](#) event was canceled, then this will be the last iteration. Run the following steps, then stop the drag-and-drop

operation:

1. If the [current drag operation](#) is "[none](#)" (no drag operation), or, if the user ended the drag-and-drop operation by canceling it (e.g. by hitting the **Escape** key), or if the [current target element](#) is null, then the drag operation failed. Run these substeps:
  1. Let *dropped* be false.
  2. If the [current target element](#) is a DOM element, [fire a DND event](#) named [dragleave](#) at it; otherwise, if it is not null, use platform-specific conventions for drag cancelation.
  3. Set the [current drag operation](#) to "[none](#)".

Otherwise, the drag operation might be a success; run these substeps:

1. Let *dropped* be true.
2. If the [current target element](#) is a DOM element, [fire a DND event](#) named [drop](#) at it; otherwise, use platform-specific conventions for indicating a drop.
3. If the event is canceled, set the [current drag operation](#) to the value of the [dropEffect](#) attribute of the [DragEvent](#) object's [dataTransfer](#) object as it stood after the event [dispatch](#) finished.

Otherwise, the event is not canceled; perform the event's default action, which depends on the exact target as follows:

If the [current target element](#) is a text control (e.g., [textarea](#), or an [input](#) element whose [type](#) attribute is in the [Text](#) state) or an [editing host](#) or [editable](#) element, and the [drag data store item list](#) has an item with the [drag data item type string](#) "[text/plain](#)" and the [drag data item kind](#) [text](#)

Insert the actual data of the first item in the [drag data store item list](#) to have a [drag data item type string](#) of "[text/plain](#)" and a [drag data item kind](#) that is *text* into the text control or [editing host](#) or [editable](#) element in a manner consistent with platform-specific conventions (e.g. inserting it at the current mouse cursor position, or inserting it at the end of the field).

Otherwise

Reset the [current drag operation](#) to "[none](#)".

2. Fire a DND event named [dragend](#) at the [source node](#).
3. Run the appropriate steps from the following list as the default action of the [dragend](#) event:

If *dropped* is true, the [current target element](#) is a *text control* (see below), the [current drag operation](#) is "[move](#)", and the source of the drag-and-drop operation is a selection in the DOM that is entirely contained within an [editing host](#)

[Delete the selection.](#)

If *dropped* is true, the [current target element](#) is a *text control* (see below), the [current drag operation](#) is "[move](#)", and the source of the drag-and-drop operation is a selection in a text control

The user agent should delete the dragged selection from the relevant text control.

If *dropped* is false or if the [current drag operation](#) is "[none](#)"

The drag was canceled. If the platform conventions dictate that this be represented to the user (e.g. by animating the dragged selection going back to the source of the drag-and-drop operation), then do so.

Otherwise

The event has no default action.

For the purposes of this step, a *text control* is a [textarea](#) element or an [input](#) element whose [type](#) attribute is in one of the [Text](#), [Search](#), [Tel](#), [URL](#), [Email](#), [Password](#), or [Number](#) states.

User agents are encouraged to consider how to react to drags near the edge of scrollable regions. For example, if a user drags a link to the bottom of the [viewport](#) on a long page, it might make sense to scroll the page so that the user can drop the link lower on the page.

This model is independent of which [Document](#) object the nodes involved are from; the events are fired as described above and the rest of the processing model runs as described above, irrespective of how many documents are involved in the operation.

#### 6.10.6 Events summary

*This section is non-normative.*

The following events are involved in the drag-and-drop model.

Event name	Target	Cancelable?	Drag data store mode	<a href="#">dropEffect</a>	Default Action
------------	--------	-------------	-------------------------------	----------------------------	----------------

### *dragstart*

✓MDN

#### [Document/dragstart\\_event](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 4+ [Source node](#)  
 Opera 12+ Edge 79+ [Source node](#)  
 Edge (Legacy) 12+ Internet Explorer 10+ [Source node](#)

Firefox Android No Safari

iOS 11+ Chrome  
 Android No WebView  
 Android No Samsung  
 Internet No Opera Android No

### *drag*

MDN

#### [Document/drag\\_event](#)

Firefox 3.5+ Safari 3.1+ Chrome 4+  
 Opera 12+ Edge 79+ [Source node](#)  
 Edge (Legacy) 12+ Internet Explorer 10+ [Source node](#)

Firefox Android No Safari

iOS 11+ Chrome  
 Android No WebView  
 Android No Samsung  
 Internet No Opera Android No

### *dragenter*

✓MDN

#### [Document/dragenter\\_event](#)

Support in all current engines.

Firefox 3.5+ Safari 3.1+ Chrome 4+  
 Opera 12+ Edge 79+ [Source node](#)

[Immediate user selection](#) or [the body element](#)

✓ Cancelable [Protected mode](#)

[Based on effectAllowed value](#)

Reject [immediate user selection](#) as potential target element

Initiate the drag-and-drop operation

Event name	Target	Cancelable?	Drag data store mode	<a href="#">dropEffect</a>	Default Action
Edge (Legacy)12+Internet Explorer10+					
Firefox AndroidNoSafari iOS11+Chrome AndroidNoWebView AndroidNoSamsung InternetNoOpera AndroidNo					
<i>dragleave</i>					
					

## [Document/dragleave\\_event](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome4+ Opera12+Edge79+	<a href="#">Previous target element</a>	—	<a href="#">Protected mode</a>	"none"	None
Edge (Legacy)12+Internet Explorer10+					
Firefox AndroidNoSafari iOS11+Chrome AndroidNoWebView AndroidNoSamsung InternetNoOpera AndroidNo					
<i>dragover</i>					
					

## [Document/dragover\\_event](#)

Support in all current engines.

Firefox3.5+Safari3.1+Chrome4+ Opera12+Edge79+	<a href="#">Current target element</a>	✓	<a href="#">Protected mode</a>	<a href="#">Based on effectAllowed value</a>	Reset the current drag operation to "none"
Edge (Legacy)12+Internet Explorer10+		Cancelable			
Firefox AndroidNoSafari iOS11+Chrome AndroidNoWebView AndroidNoSamsung InternetNoOpera AndroidNo					
<i>drop</i>	<a href="#">Current target</a>	✓	Cancelable	<a href="#">Read-only</a>	<a href="#">Current drag operation</a>
					Varies

Event name	Target	Cancelable?	Drag data store mode	<a href="#">dropEffect</a>	Default Action
✓MDN					

## [Document/drop\\_event](#)

Support in all current engines.

Firefox 3.5+	Safari 3.1+	Chrome 4+	
Opera 12+	Edge 79+		<a href="#">element</a>
Edge (Legacy)	12+	Internet	
Explorer 10+			

Firefox	Android	NoSafari	
iOS 11+	Chrome		
Android	NoWebView		
Android	NoSamsung		
Internet	NoOpera	Android	No

## *dragend*

MDN

## [Document/dragend\\_event](#)

Firefox	3.5+	Safari 3.1+	Chrome 4+		
Opera 12+	Edge 79+		<a href="#">Source</a>		
Edge (Legacy)	12+	Internet		<a href="#">node</a>	
Explorer 10+					

Firefox	Android	NoSafari		
iOS 11+	Chrome			
Android	NoWebView			
Android	NoSamsung			
Internet	NoOpera	Android	No	

Protected	Current drag		
<a href="#">mode</a>	<a href="#">operation</a>		Varies

All of these events bubble, are composed, and the [effectAllowed](#) attribute always has the value it had after the [dragstart](#) event, defaulting to "[uninitialized](#)" in the [dragstart](#) event.

### 6.10.7 The [draggable](#) attribute

✓MDN

## [Global\\_attributes/draggable](#)

Support in all current engines.

Firefox 2+ Safari Yes Chrome Yes

---

Opera 12+ Edge Yes

---

Edge (Legacy) 12+ Internet Explorer Yes

---

Firefox Android 4+ Safari iOS Yes Chrome Android Yes WebView Android Yes Samsung

Internet Yes Opera Android Yes

All [HTML elements](#) may have the **draggable** content attribute set. The [draggable](#) attribute is an [enumerated attribute](#). It has three states. The first state is *true* and it has the keyword **true**. The second state is *false* and it has the keyword **false**. The third state is *auto*; it has no keywords but it is the [missing value default](#) and the [invalid value default](#).

The *true* state means the element is draggable; the *false* state means that it is not. The *auto* state uses the default behavior of the user agent.

An element with a [draggable](#) attribute should also have a [title](#) attribute that names the element for the purpose of non-visual interactions.

### **`element.draggable [ = value ]`**

Returns true if the element is draggable; otherwise, returns false.

Can be set, to override the default and set the [draggable](#) content attribute.

The **draggable** IDL attribute, whose value depends on the content attribute's in the way described below, controls whether or not the element is draggable. Generally, only text selections are draggable, but elements whose [draggable](#) IDL attribute is true become draggable as well.

If an element's [draggable](#) content attribute has the state *true*, the [draggable](#) IDL attribute must return true.

Otherwise, if the element's [draggable](#) content attribute has the state *false*, the [draggable](#) IDL attribute must return false.

Otherwise, the element's [draggable](#) content attribute has the state *auto*. If the element is an [img](#) element, an [object](#) element that [represents](#) an image, or an [a](#) element with an [href](#) content attribute, the [draggable](#) IDL attribute must return true; otherwise, the [draggable](#) IDL attribute must return false.

If the [draggable](#) IDL attribute is set to the value *false*, the [draggable](#) content attribute must be set to the literal value "**false**". If the [draggable](#) IDL attribute is set to the value *true*, the [draggable](#) content attribute must be set to the literal value "**true**".

### 6.10.8 Security risks in the drag-and-drop model

User agents must not make the data added to the [DataTransfer](#) object during the [dragstart](#) event available to scripts until the [drop](#) event, because otherwise, if a user were to drag sensitive information from one document to a second document, crossing a hostile third document in the process, the hostile document could intercept the data.

For the same reason, user agents must consider a drop to be successful only if the user specifically ended the drag operation — if any scripts end the drag operation, it must be considered unsuccessful (canceled) and the [drop](#) event must not be fired.

User agents should take care to not start drag-and-drop operations in response to script actions. For example, in a mouse-and-window environment, if a script moves a window while the user has their mouse button depressed, the UA would not consider that to start a drag. This is important because otherwise UAs could cause data to be dragged from sensitive sources and dropped into hostile documents without the user's consent.

User agents should filter potentially active (scripted) content (e.g. HTML) when it is dragged and when it is dropped, using a safelist of known-safe features. Similarly, [relative URLs](#) should be turned into absolute URLs to avoid references changing in unexpected ways. This specification does not specify how this is performed.

Consider a hostile page providing some content and getting the user to select and drag and drop (or indeed, copy and paste) that content to a victim page's [contenteditable](#) region. If the browser does not ensure that only safe content is dragged, potentially unsafe content such as scripts and event handlers in the selection, once dropped (or pasted) into the victim site, get the privileges of the victim site. This would thus enable a cross-site scripting attack.

## 7 Loading web pages

This section describes features that apply most directly to web browsers. Having said that, except where specified otherwise, the requirements defined in this section *do* apply to all user agents, whether they are web browsers or not.

### 7.1 Browsing contexts

A *browsing context* is an environment in which [Document](#) objects are presented to the user.

A tab or window in a web browser typically contains a [browsing context](#), as does an [iframe](#) or [frames](#) in a [frameset](#).

A [browsing context](#) has a corresponding [WindowProxy](#) object.

A [browsing context](#) has an *opener browsing context*, which is null or a [browsing context](#). It is initially null.

A [browsing context](#) has a *disowned* boolean. It is initially false.

A [browsing context](#) has an *is closing* boolean. It is initially false.

The following example illustrates the various possibilities of a [browsing context](#). It can be [disowned](#), [is closing](#), neither, or both.

```
// Neither disowned nor is closing:
const popup1 = window.open();

// Disowned, but not is closing:
const popup2 = window.open();
popup2.opener = null;

// Not disowned, but is closing:
const popup3 = window.open();
popup3.close();

// Disowned, is closing:
const popup4 = window.open();
popup4.opener = null;
popup4.close();
```

A [browsing context](#) has a [session history](#), which lists the [Document](#) objects that the [browsing context](#) has presented, is presenting, or will present. A [Document](#)'s *browsing context* is the [browsing context](#) whose [session history](#) contains the [Document](#), if any such browsing context exists and has not been [discarded](#), and null otherwise.

A [Document](#) does not necessarily have a non-null [browsing context](#). In particular, data mining tools are likely to never instantiate browsing contexts. A [Document](#) created using an API such as [createDocument\(\)](#) never has a non-null [browsing context](#). And the [Document](#) originally created for an [iframe](#) element, which has since been [removed from the document](#), has no associated browsing context, since that browsing context was [discarded](#).

A [browsing context](#)'s *active window* is its [WindowProxy](#) object's [\[\[Window\]\]](#) internal slot value. A [browsing context](#)'s *active document* is its [active window](#)'s [associated Document](#).

In general, there is a 1-to-1 mapping from the [Window](#) object to the [Document](#) object, as long as the [Document](#) object has a non-null [browsing context](#). There is one exception. A [Window](#) can be reused for the presentation of a second [Document](#) in the same [browsing context](#), such that the mapping is then 1-to-2. This occurs when a [browsing context](#) is [navigated](#) from the [initial about:blank Document](#) to another, with [historyHandling](#) set to "[replace](#)".

A [browsing context](#) has a *virtual browsing context group ID* integer. It is initially 0. This is used by [cross-origin opener policy reporting](#), to keep track of the browsing context group switches that would have happened if the report-only policy had been enforced.

A [browsing context](#) has an *initial URL*, which is a [URL](#) or null. It is initially null.

A [browsing context](#) has an *opener origin at creation*, which is an [origin](#) or null. It is initially null.

### 7.1.1 Creating browsing contexts

To set the active document of a [browsing context](#) `browsingContext` to a [Document](#) object `document`, run these steps:

1. Let `window` be `document`'s [relevant global object](#).
  2. Set `document`'s [visibility state](#) to `browsingContext`'s [top-level browsing context's system visibility state](#).
  3. Set `browsingContext`'s [active window](#) to `window`.
  4. Set `window`'s [associated Document](#) to `document`.
  5. Set `window`'s [relevant settings object](#)'s [execution ready flag](#).
- 

A [browsing context](#) has an associated *creator origin* (null or returns an [origin](#)), *creator URL* (null or returns a [URL](#)), and *creator base URL* (null or returns a [URL](#)). These are all initially null.

To determine the *origin*, given [browsing context](#) `browsingContext`, [URL](#) `url`, [sandboxing flag set](#) `sandboxFlags`, and an [origin](#) `invocationOrigin`:

1. If `sandboxFlags` has its [sandboxed origin browsing context flag](#) set, then return a new [opaque origin](#).
2. If `url` is null, then return a new [opaque origin](#).
3. If `invocationOrigin` is non-null and `url` matches [about:blank](#), then return `invocationOrigin`.

The result here is that two documents end up with the same underlying [origin](#), meaning that [document.domain](#) affects both.

4. If `url` is [about:srcdoc](#), then return the [origin](#) of `browsingContext`'s [container document](#).
5. Return `url`'s [origin](#).

To create a new [browsing context](#), given null or a [Document](#) object `creator`, null or an element `embedder`, and a [browsing context group](#) `group`, run these steps:

1. Let *browsingContext* be a new [browsing context](#).
  2. If *creator* is non-null, then set *browsingContext*'s [creator origin](#) to return *creator's origin*, *browsingContext*'s [creator URL](#) to return *creator's URL*, *browsingContext*'s [creator base URL](#) to return *creator's base URL*, and *browsingContext*'s [virtual browsing context group ID](#) to *creator's top-level browsing context*'s [virtual browsing context group ID](#).
  3. Let *sandboxFlags* be the result of [determining the creation sandboxing flags](#) given *browsingContext* and *embedder*.
  4. Let *origin* be the result of [determining the origin](#) given *browsingContext*, [about:blank](#), *sandboxFlags*, and *browsingContext*'s [creator origin](#).
  5. Let *permissionsPolicy* be the result of [creating a permissions policy](#) given *browsingContext* and *origin*. [\[PERMISSIONSPOLICY\]](#)
- This needs to use *embedder*.
6. Let *agent* be the result of [obtaining a similar-origin window agent](#) given *origin*, *group*, and false.
  7. Let *realm execution context* be the result of [creating a new JavaScript realm](#) given *agent* and the following customizations:
    - For the global object, create a new [Window](#) object.
    - For the global this binding, use *browsingContext*'s [WindowProxy](#) object.
  8. Let *topLevelCreationURL* be [about:blank](#) if *embedder* is null; otherwise *embedder*'s [relevant settings object](#)'s [top-level creation URL](#).
  9. Let *topLevelOrigin* be *origin* if *embedder* is null; otherwise *embedder*'s [relevant settings object](#)'s [top-level origin](#).
  10. Set up a window environment settings object with [about:blank](#), *realm execution context*, null, *topLevelCreationURL*, and *topLevelOrigin*.
  11. Let *coop* be a new [cross-origin opener policy](#).
  12. If *creator* is non-null and *creator's origin* is [same origin](#) with *creator's relevant settings object*'s [top-level origin](#), then set *coop* to *creator's browsing context*'s [top-level browsing context](#)'s [active document](#)'s [cross-origin opener policy](#).
  13. Let *document* be a new [Document](#), marked as an [HTML document](#) in [quirks mode](#), whose [content type](#) is "text/html", [origin](#) is *origin*, [active sandboxing flag set](#) is *sandboxFlags*, [permissions policy](#) is *permissionsPolicy*, [cross-origin opener policy](#) is *coop*, [navigation id](#) is null, and which is [ready for post-load tasks](#).

14. Assert: *document*'s [URL](#) and *document*'s [relevant settings object](#)'s [creation URL](#) are [about:blank](#).
15. Set *document*'s [is initial about:blank](#) to true.
16. Ensure that *document* has a single child [html](#) node, which itself has two empty child nodes: a [head](#) element, and a [body](#) element.
17. [Set the active document](#) of *browsingContext* to *document*.
18. If *browsingContext*'s [creator URL](#) is non-null, then set *document*'s [referrer](#) to the [serialization](#) of it.
19. If *creator* is non-null, then set *document*'s [policy container](#) to a [clone](#) of *creator*'s [policy container](#).
20. Append a new [session history entry](#) to *browsingContext*'s [session history](#) whose [URL](#) is [about:blank](#) and [document](#) is *document*.
21. [Completely finish loading](#) *document*.
22. Return *browsingContext*.

To *create a new top-level browsing context*:

1. Let *group* be the result of [creating a new browsing context group](#).
2. Return *group*'s [browsing context set](#)[0].

This creates a [top-level browsing context](#).

To *create a new auxiliary browsing context*, given a [browsing context opener](#):

1. Let *group* be *opener*'s [top-level browsing context](#)'s [group](#)
2. Assert: *group* is non-null, as [navigating](#) invokes this directly.
3. Let *browsingContext* be the result of [creating a new browsing context](#) with *opener*'s [active document](#), null, and *group*.
4. [Append](#) *browsingContext* to *group*.
5. Set *browsingContext*'s [opener browsing context](#) to *opener*.
6. Set *browsingContext*'s [virtual browsing context group ID](#) to *opener*'s [top-level browsing context](#)'s [virtual browsing context group ID](#).
7. Set *browsingContext*'s [opener origin at creation](#) to *opener*'s [active document](#)'s [origin](#).

8. [Legacy-clone a browsing session storage shed](#) with *opener*'s [browsing session](#) and *browsingContext*'s [browsing session](#). [STORAGE]
9. Return *browsingContext*.

This creates a [top-level browsing context](#) that is also an [auxiliary browsing context](#).

To create a new nested browsing context, given an element *element*:

1. Let *group* be *element*'s [node document](#)'s [browsing context](#)'s [top-level browsing context](#)'s [group](#).
2. Let *browsingContext* be the result of [creating a new browsing context](#) with *element*'s [node document](#), *element*, and *group*.
3. Set *element*'s [nested browsing context](#) to *browsingContext*.
4. If *element* has a [name](#) attribute, then set *browsingContext*'s [name](#) to the value of this attribute.

### 7.1.2 Related browsing contexts

Certain elements (for example, [iframe](#) elements) can instantiate further [browsing contexts](#). These elements are called *browsing context containers*.

Each [browsing context container](#) has a *nested browsing context*, which is either a [browsing context](#) or null. It is initially null.

The *container* of a [browsing context](#) *bc* is the [browsing context container](#) whose [nested browsing context](#) is *bc*, or null if there is no such element.

Each [browsing context](#) *bc* has a *container document*, which is the result of running these steps:

1. If *bc*'s [container](#) is null, then return null.
2. Return *bc*'s [container](#)'s [node document](#).

This is equal to *bc*'s [container](#)'s [shadow-including root](#) as *bc*'s [container](#) has to be [connected](#).

A [browsing context](#) *child* is said to be a *child browsing context* of another [browsing context](#) *parent*, if *child*'s [container document](#) is non-null and *child*'s [container document](#)'s [browsing context](#) is *parent*.

A [browsing context](#) *child* is a *document-tree child browsing context* of *parent* if *child* is a [child browsing context](#) and *child*'s [container](#) is [in a document tree](#).

A [browsing context](#) *child* may have a *parent browsing context*. This is the unique [browsing](#)

[context](#) that has *child* as a [child browsing context](#), if any such browsing context exists. Otherwise, the [browsing context](#) has no [parent browsing context](#).

A [browsing context](#) *A* is said to be an *ancestor* of a browsing context *B* if there exists a browsing context *A'* that is a [child browsing context](#) of *A* and that is itself an [ancestor](#) of *B*, or if the browsing context *A* is the [parent browsing context](#) of *B*.

A [browsing context](#) that has no [parent browsing context](#) is the *top-level browsing context* for itself and all of the browsing contexts for which it is an [ancestor browsing context](#).

---

A [top-level browsing context](#) has an associated *group* (null or a [browsing context group](#)). It is initially null.

A [top-level browsing context](#) has an *is popup* boolean. It is initially false.

The only mandatory impact in this specification of [is popup](#) is on the [visible](#) getter of the relevant [BarProp](#) objects. However, user agents might also use it in the following ways:

- Deciding whether or not to provide a minimal web browser user interface for the [browsing context](#).
- Performing the optional steps in [set up browsing context features](#).

In both cases user agents might additionally incorporate user preferences, or present a choice as to whether to go down the popup route.

User agents that provides a minimal web browser user interface for such popups are encouraged to not hide the browser's location bar.

---

It is possible to create new browsing contexts that are related to a [top-level browsing context](#) while their [container](#) is null. Such browsing contexts are called *auxiliary browsing contexts*. Auxiliary browsing contexts are always [top-level browsing contexts](#).

The transitive closure of [parent browsing contexts](#) for a [browsing context](#) that is a [child browsing context](#) gives the list of [ancestor browsing contexts](#).

The *list of the descendant browsing contexts* of a [Document](#) *d* is the (ordered) list returned by the following algorithm:

1. Let *list* be an empty [list](#).
2. For each [browsing context container](#) *container*, whose [nested browsing context](#) is non-null and whose [shadow-including root](#) is *d*, in [shadow-including tree order](#):
  1. Let *nestedBC* be *container*'s [nested browsing context](#).
  2. [Append](#) *nestedBC* to *list*.

3. Extend *list* with the [list of the descendant browsing contexts](#) of *nestedBC's active document*.
3. Return *list*.

A [Document](#) *d* is said to be *fully active* when *d*'s [browsing context](#) is non-null, *d*'s [browsing context's active document](#) is *d*, and either *d*'s [browsing context](#) is a [top-level browsing context](#), or *d*'s [browsing context's container document](#) is [fully active](#).

Because they are associated with an element, [child browsing contexts](#) are always tied to a specific [Document](#) in their [parent browsing context](#). User agents must not allow the user to interact with [child browsing contexts](#) of elements that are in [Documents](#) that are not themselves [fully active](#).

The following example illustrates the differences between [active](#) and [fully active Document](#) objects. Here **a.html** is loaded into a browser window, **b-1.html** starts out loaded into an [iframe](#) as shown, and **b-2.html** and **c.html** are omitted (they can simply be an empty document).

```
<!-- a.html -->
<!DOCTYPE html>
<html lang="en">
<title>Browsing context A</title>

<iframe src="b-1.html"></iframe>
<button onclick="frames[0].location.href = 'b-2.html'">Click me</button>

<!-- b-1.html -->
<!DOCTYPE html>
<html lang="en">
<title>Browsing context B</title>

<iframe src="c.html"></iframe>
```

At this point, the documents given by **a.html**, **b-1.html**, and **c.html** are all the [active documents](#) of their respective [browsing contexts](#). They are also all [fully active](#).

After clicking on the [button](#), and thus loading a new [Document](#) from **b-2.html** into browsing context B, we have the following results:

- The **a.html Document** remains both the [active document](#) of browsing context A, and [fully active](#).
- The **b-1.html Document** is now *not* the [active document](#) of browsing context B. As such it is also not [fully active](#).
- The new **b-2.html Document** is now the [active document](#) of browsing context B, and

is also [fully active](#).

- The `c.html Document` is still the [active document](#) of browsing context C. However, since C's [container document](#) is the `b-1.html Document`, which is itself not [fully active](#), this means the `c.html Document` is now not [fully active](#) (even though it is [active](#)).

For more explorations of the complexities involved here, especially as it impacts [the session history](#), see *A Model of Navigation History*. [\[NAVMODEL\]](#)

A [child browsing context](#) can be put into a *delaying load events mode*. This is used when it is [navigated](#), to [delay the load event](#) of its [container](#) before the new [Document](#) is created.

The *document family* of a [browsing context](#) consists of the union of all the [Document](#) objects in that [browsing context's session history](#) and the [document families](#) of all those [Document](#) objects. The [document family](#) of a [Document](#) object consists of the union of all the [document families](#) of the [browsing contexts](#) in the [list of the descendant browsing contexts](#) of the [Document](#) object.

The *content document* of a [browsing context container](#) [container](#) is the result of the following algorithm:

1. If [container's nested browsing context](#) is null, then return null.
2. Let [context](#) be [container's nested browsing context](#).
3. Let [document](#) be [context's active document](#).
4. If [document's origin](#) and [container's node document's origin](#) are not [same origin-domain](#), then return null.
5. Return [document](#).

#### 7.1.2.1 Navigating related browsing contexts in the DOM

##### `window.top`



##### [Window/top](#)

Support in all current engines.

Firefox 1+ | Safari 3+ | Chrome 1+

---

Opera 12.1+ | Edge 79+

---

Edge (Legacy) 12+ | Internet Explorer 4+

---

Firefox Android 4+ | Safari iOS 1+ | Chrome Android 18+ | WebView Android 1+ | Samsung

Internet1.0+ Opera Android12.1+

Returns the [WindowProxy](#) for the [top-level browsing context](#).

### **window.opener [ = value ]**

✓MDN

#### [Window/opener](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

Opera3+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Returns the [WindowProxy](#) for the [opener](#) browsing context.

Returns null if there isn't one or if it has been set to null.

Can be set to null.

### **window.parent**

✓MDN

#### [Window/parent](#)

Support in all current engines.

Firefox1+Safari1.3+Chrome1+

Opera3+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Returns the [WindowProxy](#) for the [parent](#) browsing context.

### **window.frameElement**

✓MDN

#### [Window/frameElement](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer5.5+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Returns the [Element](#) for the [browsing context container](#).

Returns null if there isn't one, and in cross-origin situations.

The *top* attribute's getter must run these steps:

1. If this [Window](#) object's [browsing context](#) is null, then return null.
2. Return this [Window](#) object's [browsing context](#)'s [top-level browsing context](#)'s [WindowProxy](#) object.

The *opener* getter steps are:

1. Let *current* be [this](#)'s [browsing context](#).
2. If *current* is null, then return null.
3. If *current*'s [disowned](#) is true, then return null.
4. If *current*'s [opener browsing context](#) is null, then return null.
5. Return *current*'s [opener browsing context](#)'s [WindowProxy](#) object.

The *opener* setter steps are:

1. If the given value is null and [this](#)'s [browsing context](#) is non-null, then set [this](#)'s [browsing context](#)'s [disowned](#) to true.
2. If the given value is non-null, then return ? [OrdinaryDefineOwnProperty\(this, "opener", { \[\[Value\]\]: the given value, \[\[Writable\]\]: true, \[\[Enumerable\]\]: true, \[\[Configurable\]\]: true }\)](#).

If a [browsing context](#)'s [disowned](#) is true, its [window.opener](#) attribute is null. That prevents scripts in the [browsing context](#) from changing any properties of its [opener browsing context](#)'s [Window](#) object (i.e., the [Window](#) object from which the [browsing context](#) was created).

Otherwise, if a [browsing context](#)'s [disowned](#) is false, then scripts in that [browsing context](#) can use [window.opener](#) to change properties of its [opener browsing context](#)'s [Window](#) object. For example, a script running in the [browsing context](#) can change the value of [window.opener.location](#), causing the [opener browsing context](#) to navigate to a completely different document.

The *parent* attribute's getter must run these steps:

1. Let *current* be this [Window](#) object's [browsing context](#).
2. If *current* is null, then return null.
3. If *current* is a [child browsing context](#) of another [browsing context](#) *parent*, then return *parent*'s [WindowProxy](#) object.
4. Assert: *current* is a [top-level browsing context](#).
5. Return *current*'s [WindowProxy](#) object.

The *frameElement* getter steps are:

1. Let *current* be this [Window](#) object's [browsing context](#).
2. If *current* is null, then return null.
3. Let *container* be *current*'s [container](#).
4. If *container* is null, then return null.
5. If *container*'s [node document](#)'s [origin](#) is not [same origin-domain](#) with the [current settings object](#)'s [origin](#), then return null.
6. Return *container*.

An example of when these IDL attributes can return null is as follows:

```
<!DOCTYPE html>
<iframe></iframe>

<script>
"use strict";
const element = document.querySelector("iframe");
const iframeWindow = element.contentWindow;
element.remove();

console.assert(iframeWindow.top === null);
console.assert(iframeWindow.parent === null);
console.assert(iframeWindow.frameElement === null);
</script>
```

Here the [browsing context](#) corresponding to `iframeWindow` was [discarded](#) when `element` was removed from the document.

### 7.1.3 Security

A [browsing context](#)  $A$  is *familiar with* a second [browsing context](#)  $B$  if one of the following conditions is true:

- Either the [origin](#) of the [active document](#) of  $A$  is the [same](#) as the [origin](#) of the [active document](#) of  $B$ , or
  - The browsing context  $A$  is a [child browsing context](#) and its [top-level browsing context](#) is  $B$ , or
  - The browsing context  $B$  is an [auxiliary browsing context](#) and  $A$  is [familiar with](#)  $B$ 's [opener browsing context](#), or
  - The browsing context  $B$  is not a [top-level browsing context](#), but there exists an [ancestor browsing context](#) of  $B$  whose [active document](#) has the [same origin](#) as the [active document](#) of  $A$  (possibly in fact being  $A$  itself).
- 

A [browsing context](#)  $A$  is *allowed to navigate* a second [browsing context](#)  $B$  if the following algorithm returns true:

1. If  $A$  is not the same [browsing context](#) as  $B$ , and  $A$  is not one of the [ancestor browsing contexts](#) of  $B$ , and  $B$  is not a [top-level browsing context](#), and  $A$ 's [active document](#)'s [active sandboxing flag set](#) has its [sandboxed navigation browsing context flag set](#), then return false.
  2. Otherwise, if  $B$  is a [top-level browsing context](#), and is one of the [ancestor browsing contexts](#) of  $A$ , then:
    1. If  $A$ 's [active window](#) has [transient activation](#) and  $A$ 's [active document](#)'s [active sandboxing flag set](#) has its [sandboxed top-level navigation with user activation browsing context flag set](#), then return false.
    2. Otherwise, if  $A$ 's [active window](#) does not have [transient activation](#) and  $A$ 's [active document](#)'s [active sandboxing flag set](#) has its [sandboxed top-level navigation without user activation browsing context flag set](#), then return false.
  3. Otherwise, if  $B$  is a [top-level browsing context](#), and is neither  $A$  nor one of the [ancestor browsing contexts](#) of  $A$ , and  $A$ 's [Document](#)'s [active sandboxing flag set](#) has its [sandboxed navigation browsing context flag set](#), and  $A$  is not the [one permitted sandboxed navigator](#) of  $B$ , then return false.
  4. Return true.
- 

An element has a *browsing context scope origin* if its [Document](#)'s [browsing context](#) is a [top-level browsing context](#) or if all of its [Document](#)'s [ancestor browsing contexts](#) all have [active documents](#) whose [origins](#) are the [same origin](#) as the element's [node document](#)'s [origin](#). If an element has a [browsing context scope origin](#), then its value is the [origin](#) of the element's [node](#).

[document](#).

#### 7.1.4 Groupings of browsing contexts

A user agent holds a *browsing context group set* (a [set](#) of [browsing context groups](#)).

A *browsing context group* holds a *browsing context set* (a [set](#) of [top-level browsing contexts](#)).

A [top-level browsing context](#) is added to the [group](#) when the group is [created](#). All subsequent [top-level browsing contexts](#) added to the [group](#) will be [auxiliary browsing contexts](#).

A [browsing context group](#) has an associated *agent cluster map* (a weak [map](#) of [agent cluster keys](#) to [agent clusters](#)). User agents are responsible for collecting agent clusters when it is deemed that nothing can access them anymore.

A [browsing context group](#) has an associated *historical agent cluster key map*, which is a [map](#) of [origins](#) to [agent cluster keys](#). This map is used to ensure the consistency of the [origin-keyed agent clusters](#) feature by recording what agent cluster keys were previously used for a given origin.

The [historical agent cluster key map](#) only ever gains entries over the lifetime of the browsing context group.

A [browsing context group](#) has a *cross-origin isolation mode*, which is a [cross-origin isolation mode](#). It is initially "[none](#)".

A *cross-origin isolation mode* is one of three possible values: "[none](#)", "[logical](#)", or "[concrete](#)".

"[logical](#)" and "[concrete](#)" are similar. They are both used for [browsing context groups](#) where:

- every top-level [Document](#) has '[Cross-Origin-Opener-Policy](#): [same-origin](#)', and
- every [Document](#) has a '[Cross-Origin-Embedder-Policy](#)' header whose value is [compatible with cross-origin isolation](#).

On some platforms, it is difficult to provide the security properties required to grant safe access to the APIs gated by the [cross-origin isolated capability](#). As a result, only "[concrete](#)" can grant access that capability. "[logical](#)" is used on platform not supporting this capability, where various restrictions imposed by cross-origin isolation will still apply, but the capability is not granted.

To *create a new browsing context group*, run these steps:

1. Let *group* be a new [browsing context group](#).

2. [Append](#) *group* to the user agent's [browsing context group set](#).
3. Let *browsingContext* be the result of [creating a new browsing context](#) with null, null, and *group*.
4. [Append](#) *browsingContext* to *group*.
5. Return *group*.

To [append](#) a [top-level browsing context](#) *browsingContext* to a [browsing context group](#) *group*, run these steps:

1. [Append](#) *browsingContext* to *group*'s [browsing context set](#).
2. Set *browsingContext*'s [group](#) to *group*.

To [remove](#) a [top-level browsing context](#) *browsingContext*, run these steps:

1. Assert: *browsingContext*'s [group](#) is non-null, because a [browsing context](#) only gets [discarded](#) once.
2. Let *group* be *browsingContext*'s [group](#).
3. Set *browsingContext*'s [group](#) to null.
4. [Remove](#) *browsingContext* from *group*'s [browsing context set](#).
5. If *group*'s [browsing context set is empty](#), then [remove](#) *group* from the user agent's [browsing context group set](#).

[Append](#) and [remove](#) are primitive operations that help define the lifetime of a [browsing context group](#). They are called from [creating a new browsing context group](#), [creating a new auxiliary browsing context](#), and [discarding a browsing context](#).

---

The HTML Standard used to define "unit of related browsing contexts" and "unit of related similar-origin browsing contexts". These have been removed as they were not adequate.

### 7.1.5 Browsing context names

Browsing contexts can have a *browsing context name*. Unless stated otherwise, it is the empty string.

A *valid browsing context name* is any string with at least one character that does not start with a U+005F LOW LINE character. (Names starting with an underscore are reserved for special keywords.)

A *valid browsing context name or keyword* is any string that is either a [valid browsing context](#)

name or that is an [ASCII case-insensitive](#) match for one of: `_blank`, `_self`, `_parent`, or `_top`.

These values have different meanings based on whether the page is sandboxed or not, as summarized in the following (non-normative) table. In this table, "current" means the [browsing context](#) that the link or script is in, "parent" means the [parent browsing context](#) of the one the link or script is in, "top" means the [top-level browsing context](#) of the one the link or script is in, "new" means a new [top-level browsing context](#) or [auxiliary browsing context](#) is to be created, subject to various user preferences and user agent policies, "none" means that nothing will happen, and "maybe new" means the same as "new" if the "[allow-popups](#)" keyword is also specified on the [sandbox](#) attribute (or if the user overrode the sandboxing), and the same as "none" otherwise.

Keyword	Ordinary effect	Effect in an <a href="#">iframe</a> with... <code>sandbox="" sandbox="allow-top-navigation"</code>	
none specified, for links and form submissions	current	current	current
empty string	current	current	current
<code>_blank</code>	new	maybe new	maybe new
<code>_self</code>	current	current	current
<code>_parent</code> if there isn't a parent	current	current	current
<code>_parent</code> if parent is also top	parent/top	none	parent/top
<code>_parent</code> if there is one and it's not top	parent	none	none
<code>_top</code> if top is current	current	current	current
<code>_top</code> if top is not current	top	none	top
name that doesn't exist	new	maybe new	maybe new
name that exists and is a descendant	specified descendant	specified descendant	specified descendant
name that exists and is current	current	current	current
name that exists and is an ancestor that is top	specified ancestor	none	specified ancestor/top
name that exists and is an ancestor that is not top	specified ancestor	none	none
other name that exists with common top	specified	none	none
name that exists with different top, if <a href="#">familiar</a> and <a href="#">one permitted sandboxed navigator</a>	specified	specified	specified
name that exists with different top, if <a href="#">familiar</a> but not <a href="#">one permitted sandboxed navigator</a>	specified	none	none
name that exists with different top, not <a href="#">familiar</a>	new	maybe new	maybe new

Most of the restrictions on sandboxed browsing contexts are applied by other algorithms, e.g. the [navigation](#) algorithm, not [the rules for choosing a browsing context](#) given below.

---

The rules for choosing a browsing context, given a [browsing context name](#) *name*, a [browsing context](#) *current*, and a boolean *noopener* are as follows:

1. Let *chosen* be null.
2. Let *windowType* be "existing or none".
3. Let *sandboxingFlagSet* be *current*'s [active document](#)'s [active sandboxing flag set](#).
4. If *name* is the empty string or an [ASCII case-insensitive](#) match for "`_self`", then set *chosen* to *current*.
5. Otherwise, if *name* is an [ASCII case-insensitive](#) match for "`_parent`", set *chosen* to *current*'s [parent browsing context](#), if any, and *current* otherwise.
6. Otherwise, if *name* is an [ASCII case-insensitive](#) match for "`_top`", set *chosen* to *current*'s [top-level browsing context](#), if any, and *current* otherwise.
7. Otherwise, if *name* is not an [ASCII case-insensitive](#) match for "`_blank`", there exists a browsing context whose [name](#) is the same as *name*, *current* is [familiar with](#) that browsing context, and the user agent determines that the two browsing contexts are related enough that it is ok if they reach each other, set *chosen* to that browsing context. If there are multiple matching browsing contexts, the user agent should set *chosen* to one in some arbitrary consistent manner, such as the most recently opened, most recently focused, or more closely related.

This will be made more precise in [issue #313](#).

8. Otherwise, a new browsing context is being requested, and what happens depends on the user agent's configuration and abilities — it is determined by the rules given for the first applicable option from the following list:

If *current*'s [active window](#) does not have [transient activation](#) and the user agent has been configured to not show popups (i.e., the user agent has a "popup blocker" enabled)

The user agent may inform the user that a popup has been blocked.

If *sandboxingFlagSet* has the [sandboxed auxiliary navigation browsing context flag](#) set

The user agent may report to a developer console that a popup has been blocked.

If the user agent has been configured such that in this instance it will create a new browsing context

1. Set *windowType* to "new and unrestricted".
2. If *current*'s [top-level browsing context](#)'s [active document](#)'s [cross-origin opener policy](#)'s [value](#) is "`same-origin`" or "`same-origin-plus-COEP`",

then:

1. Let *currentDocument* be *current's active document*.
2. If *currentDocument*'s [origin](#) is not [same origin](#) with *currentDocument*'s [relevant settings object](#)'s [top-level origin](#), then set *noopener* to true, *name* to "[\\_blank](#)", and *windowType* to "[new with no opener](#)".

In the presence of a [cross-origin opener policy](#), nested documents that are cross-origin with their top-level browsing context's active document always set *noopener* to true.

3. If *noopener* is true, then set *chosen* to the result of [creating a new top-level browsing context](#).
4. Otherwise:
  1. Set *chosen* to the result of [creating a new auxiliary browsing context](#) with *current*.
  2. If *sandboxingFlagSet*'s [sandboxed navigation](#) browsing context flag is set, then *current* must be set as *chosen*'s [one permitted sandboxed navigator](#).
  5. If *sandboxingFlagSet*'s [sandbox propagates to auxiliary browsing contexts](#) flag is set, then all the flags that are set in *sandboxingFlagSet* must be set in *chosen*'s [popup sandboxing flag set](#).
  6. If *name* is not an [ASCII case-insensitive](#) match for "[\\_blank](#)", then set *chosen*'s [name](#) to *name*.

If the newly created [browsing context](#) is immediately [navigated](#), then the navigation will be done with [historyHandling](#) set to "[replace](#)".

If the user agent has been configured such that in this instance it will reuse *current*

Set *chosen* to *current*.

If the user agent has been configured such that in this instance it will not find a browsing context

Do nothing.

User agents are encouraged to provide a way for users to configure the user agent to always reuse *current*.

9. Return *chosen* and *windowType*.

## 7.2 Security infrastructure for [Window](#), [WindowProxy](#), and [Location](#) objects

Although typically objects cannot be accessed across [origins](#), the web platform would not be true to itself if it did not have some legacy exceptions to that rule that the web depends upon.

### 7.2.1 Integration with IDL

When [perform a security check](#) is invoked, with a *platformObject*, *identifier*, and *type*, run these steps:

1. If *platformObject* is not a [Window](#) or [Location](#) object, then return.
2. For each *e* of ! [CrossOriginProperties](#)(*platformObject*):
  1. If [SameValue](#)(*e*.[[Property]], *identifier*) is true, then:
    1. If *type* is "**method**" and *e* has neither [[NeedsGet]] nor [[NeedsSet]], then return.
    2. Otherwise, if *type* is "**getter**" and *e*.[[NeedsGet]] is true, then return.
    3. Otherwise, if *type* is "**setter**" and *e*.[[NeedsSet]] is true, then return.
  3. If ! [IsPlatformObjectSameOrigin](#)(*platformObject*) is false, then throw a "[SecurityError](#)" [DOMException](#).

### 7.2.2 Shared internal slot: [[CrossOriginPropertyDescriptorMap]]

[Window](#) and [Location](#) objects both have a [\[\[CrossOriginPropertyDescriptorMap\]\]](#) internal slot, whose value is initially an empty map.

The [\[\[CrossOriginPropertyDescriptorMap\]\]](#) internal slot contains a map with entries whose keys are (*currentGlobal*, *objectGlobal*, *propertyKey*)-tuples and values are property descriptors, as a memoization of what is visible to scripts when *currentGlobal* inspects a [Window](#) or [Location](#) object from *objectGlobal*. It is filled lazily by [CrossOriginGetOwnPropertyHelper](#), which consults it on future lookups.

User agents should allow a value held in the map to be garbage collected along with its corresponding key when nothing holds a reference to any part of the value. That is, as long as garbage collection is not observable.

For example, with `const href = Object.getOwnPropertyDescriptor(crossOriginLocation, "href").set` the value and its corresponding key in the map cannot be garbage collected as that would be observable.

User agents may have an optimization whereby they remove key-value pairs from the map

when `document.domain` is set. This is not observable as `document.domain` cannot revisit an earlier value.

For example, setting `document.domain` to "example.com" on www.example.com means user agents can remove all key-value pairs from the map where part of the key is www.example.com, as that can never be part of the `origin` again and therefore the corresponding value could never be retrieved from the map.

### 7.2.3 Shared abstract operations

#### 7.2.3.1 `CrossOriginProperties ( O )`

1. Assert:  $O$  is a `Location` or `Window` object.
2. If  $O$  is a `Location` object, then return  $\ll \{ [[\text{Property}]]: \text{"href"}, [[\text{NeedsGet}]]: \text{false}, [[\text{NeedsSet}]]: \text{true} \}, \{ [[\text{Property}]]: \text{"replace"} \} \gg$ .
3. Return  $\ll \{ [[\text{Property}]]: \text{"window"}, [[\text{NeedsGet}]]: \text{true}, [[\text{NeedsSet}]]: \text{false} \}, \{ [[\text{Property}]]: \text{"self"}, [[\text{NeedsGet}]]: \text{true}, [[\text{NeedsSet}]]: \text{false} \}, \{ [[\text{Property}]]: \text{"location"}, [[\text{NeedsGet}]]: \text{true}, [[\text{NeedsSet}]]: \text{true} \}, \{ [[\text{Property}]]: \text{"close"} \}, \{ [[\text{Property}]]: \text{"closed"} \}, \{ [[\text{Property}]]: \text{"focus"} \}, \{ [[\text{Property}]]: \text{"blur"} \}, \{ [[\text{Property}]]: \text{"frames"} \}, \{ [[\text{Property}]]: \text{"length"} \}, \{ [[\text{Property}]]: \text{"top"} \}, \{ [[\text{Property}]]: \text{"opener"} \}, \{ [[\text{Property}]]: \text{"parent"} \}, \{ [[\text{Property}]]: \text{"postMessage"} \} \gg$ .

Indexed properties do not need to be safelisted in this algorithm, as they are handled directly by the `WindowProxy` object.

A JavaScript property name  $P$  is a *cross-origin accessible window property name* if it is "window", "self", "location", "close", "closed", "focus", "blur", "frames", "length", "top", "opener", "parent", "postMessage", or an `array index property name`.

#### 7.2.3.2 `CrossOriginPropertyFallback ( P )`

1. If  $P$  is "then", `@@toStringTag`, `@@hasInstance`, or `@@isConcatSpreadable`, then return `PropertyDescriptor{ [[Value]]: undefined, [[Writable]]: false, [[Enumerable]]: false, [[Configurable]]: true }`.
2. Throw a `"SecurityError" DOMException`.

#### 7.2.3.3 `IsPlatformObjectSameOrigin ( O )`

1. Return true if the `current settings object`'s `origin` is `same origin-domain` with  $O$ 's `relevant settings object`'s `origin`, and false otherwise.

Here the [current settings object](#) roughly corresponds to the "caller", because this check occurs before the [execution context](#) for the getter/setter/method in question makes its way onto the [JavaScript execution context stack](#). For example, in the code `w.document`, this step is invoked before the [document](#) getter is reached as part of the [\[\[Get\]\]](#) algorithm for the [WindowProxy](#) `w`.

#### 7.2.3.4 `CrossOriginGetOwnPropertyHelper( O, P )`

If this abstract operation returns undefined and there is no custom behavior, the caller needs to throw a ["SecurityError" DOMException](#). In practice this is handled by the caller calling [CrossOriginPropertyFallback](#).

1. Let `crossOriginKey` be a tuple consisting of the [current settings object](#), `O`'s [relevant settings object](#), and `P`.
2. For each `e` of [! CrossOriginProperties\(O\)](#):
  1. If [SameValue\(e.\[\[Property\]\], P\)](#) is true, then:
    1. If the value of the [\[\[CrossOriginPropertyDescriptorMap\]\]](#) internal slot of `O` contains an entry whose key is `crossOriginKey`, then return that entry's value.
    2. Let `originalDesc` be [OrdinaryGetOwnProperty\(O, P\)](#).
    3. Let `crossOriginDesc` be undefined.
  4. If `e.[[NeedsGet]]` and `e.[[NeedsSet]]` are absent, then:
    1. Let `value` be `originalDesc.[[Value]]`.
    2. If [! IsCallable\(value\)](#) is true, then set `value` to an anonymous built-in function, created in the [current Realm Record](#), that performs the same steps as the IDL operation `P` on object `O`.
    3. Set `crossOriginDesc` to [PropertyDescriptor{ \[\[Value\]\]: value, \[\[Enumerable\]\]: false, \[\[Writable\]\]: false, \[\[Configurable\]\]: true }](#).
  5. Otherwise:
    1. Let `crossOriginGet` be undefined.
    2. If `e.[[NeedsGet]]` is true, then set `crossOriginGet` to an anonymous built-in function, created in the [current Realm Record](#), that performs the same steps as the getter of the IDL attribute `P` on object `O`.
    3. Let `crossOriginSet` be undefined.

4. If  $e.[[NeedsSet]]$  is true, then set  $crossOriginSet$  to an anonymous built-in function, created in the [current Realm Record](#), that performs the same steps as the setter of the IDL attribute  $P$  on object  $O$ .
  5. Set  $crossOriginDesc$  to [PropertyDescriptor](#){ [[Get]]:  $crossOriginGet$ , [[Set]]:  $crossOriginSet$ , [[Enumerable]]: false, [[Configurable]]: true }.
  6. Create an entry in the value of the [\[\[CrossOriginPropertyDescriptorMap\]\]](#) internal slot of  $O$  with key  $crossOriginKey$  and value  $crossOriginDesc$ .
  7. Return  $crossOriginDesc$ .
3. Return undefined.

The reason that the property descriptors produced here are configurable is to preserve the [invariants of the essential internal methods](#) required by the JavaScript specification. In particular, since the value of the property can change as a consequence of navigation, it is required that the property be configurable. (However, see [tc39/ecma262 issue #672](#) and references to it elsewhere in this specification for cases where we are not able to preserve these invariants, for compatibility with existing web content.) [\[JAVASCRIPT\]](#)

The reason the property descriptors are non-enumerable, despite this mismatching the same-origin behavior, is for compatibility with existing web content. See [issue #3183](#) for details.

#### 7.2.3.5 $CrossOriginGet( O, P, Receiver )$

1. Let  $desc$  be ?  $O.[[GetOwnProperty]](P)$ .
2. Assert:  $desc$  is not undefined.
3. If ! [IsDataDescriptor](#)( $desc$ ) is true, then return  $desc.[[Value]]$ .
4. Assert: [IsAccessorDescriptor](#)( $desc$ ) is true.
5. Let  $getter$  be  $desc.[[Get]]$ .
6. If  $getter$  is undefined, then throw a ["SecurityError" DOMException](#).
7. Return ? [Call](#)( $getter, Receiver$ ).

#### 7.2.3.6 $CrossOriginSet( O, P, V, Receiver )$

1. Let  $desc$  be ?  $O.[[GetOwnProperty]](P)$ .
2. Assert:  $desc$  is not undefined.

3. If `desc.[[Set]]` is present and its value is not undefined, then:

1. Perform ? `Call(setter, Receiver, « V »)`.

2. Return true.

4. Throw a `"SecurityError"` `DOMException`.

#### 7.2.3.7 `CrossOriginOwnPropertyKeys(O)`

1. Let `keys` be a new empty `List`.

2. For each `e` of ! `CrossOriginProperties(O)`, `append` `e.[[Property]]` to `keys`.

3. Return the concatenation of `keys` and « "then", `@@toStringTag`, `@@hasInstance`, `@@isConcatSpreadable` ».

## 7.3 The `Window` object



### Window

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

```
[Global=Window,
 Exposed=Window,
 LegacyUnenumerableNamedProperties]
interface Window : EventTarget {
 // the current browsing context
 [LegacyUnforgeable] readonly attribute WindowProxy window;
 [Replaceable] readonly attribute WindowProxy self;
 [LegacyUnforgeable] readonly attribute Document document;
 attribute DOMString name;
 [PutForwards=href, LegacyUnforgeable] readonly attribute Location location;
 readonly attribute History history;
 readonly attribute CustomElementRegistry customElements;
 [Replaceable] readonly attribute BarProp locationbar;
 [Replaceable] readonly attribute BarProp menubar;
 [Replaceable] readonly attribute BarProp personalbar;
```

```

[Replaceable] readonly attribute BarProp scrollbars;
[Replaceable] readonly attribute BarProp statusbar;
[Replaceable] readonly attribute BarProp toolbar;
attribute DOMString status;
undefined close\(\);
readonly attribute boolean closed;
undefined stop\(\);
undefined focus\(\);
undefined blur\(\);

// other browsing contexts
[Replaceable] readonly attribute WindowProxy frames;
[Replaceable] readonly attribute unsigned long length;
[LegacyUnforgeable] readonly attribute WindowProxy? top;
attribute any opener;
[Replaceable] readonly attribute WindowProxy? parent;
readonly attribute Element? frameElement;
WindowProxy? open(optional USVString url = "", optional DOMString target =
getter object (DOMString name);
// Since this is the global object, the IDL named getter adds a NamedProperty
// object on the prototype chain. Indeed, this does not make the global object
// Indexed access is taken care of by the WindowProxy exotic object.

// the user agent
readonly attribute Navigator navigator;
readonly attribute Navigator clientInformation; // legacy alias of .navigator
readonly attribute boolean originAgentCluster;

// user prompts
undefined alert\(\);
undefined alert(DOMString message);
boolean confirm(optional DOMString message = "");
DOMString? prompt(optional DOMString message = "", optional DOMString default =
undefined print\(\);

undefined postMessage(any message, USVString targetOrigin, optional sequence<any>
undefined postMessage(any message, optional WindowPostMessageOptions options);

// also has obsolete members
};

Window includes GlobalEventHandlers;
Window includes WindowEventHandlers;

dictionary WindowPostMessageOptions : StructuredSerializeOptions {
 USVString targetOrigin = "/";
};

```

## [window.window](#)

 MDN

### [Window/window](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

## [window.frames](#)

 MDN

### [Window/frames](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

## [window.self](#)

 MDN

### [Window/self](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

These attributes all return *window*.

## [window.document](#)

 MDN

### [Window/document](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [Document](#) associated with *window*.

## **[document.defaultView](#)**

✓MDN

[Document/defaultView](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [Window](#) object of the [active document](#).

The [Window](#) object has an *associated Document*, which is a [Document](#) object. It is set when the [Window](#) object is created, and only ever changed during [navigation](#) from the [initial about:blank Document](#).

The [Window](#) object's *browsing context* is the [Window](#) object's [associated Document](#)'s [browsing context](#). It is either null or a [browsing context](#).

The *window*, *frames*, and *self* attributes' getters must return this [Window](#) object's [relevant Realm](#).[\[\[GlobalEnv\]\]](#)'s [EnvironmentRecord](#)'s [\[\[GlobalThisValue\]\]](#).

The *document* IDL attribute, on getting, must return this [Window](#) object's [associated Document](#).

The [Document](#) object associated with a [Window](#) object can change in exactly one case: when the [navigate](#) algorithm [creates a new Document object](#) for the first page loaded in a [browsing context](#). In that specific case, the [Window](#) object of the [initial about:blank](#) page is reused and gets a new [Document](#) object.

The *defaultView* attribute's getter, when invoked, must run these steps:

1. If this [Document](#) object's [browsing context](#) is null, then return null.
2. Return this [Document](#) object's [browsing context](#)'s [WindowProxy](#) object.

## [HTMLDocument](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

For historical reasons, [Window](#) objects must also have a writable, configurable, non-enumerable property named [HTMLDocument](#) whose value is the [Document interface object](#).

### 7.3.1 APIs for creating and navigating browsing contexts by name

**window = window.open([ url [, target [, features ] ] ])**

## [Window/open](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 3+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Opens a window to show *url* (defaults to "[about:blank](#)"), and returns it. *target* (defaults to "[\\_blank](#)") gives the name of the new window. If a window already exists with that name, it is reused. The *features* argument can contain a [set of comma-separated tokens](#):

**"noopener"**

**"noreferrer"**

These behave equivalently to the [noopener](#) and [noreferrer](#) link types on [hyperlinks](#).

**"popup"**

Encourages user agents to provide a minimal web browser user interface for the new window. (Impacts the [visible](#) getter on all [BarProp](#) objects as well.)

```
globalThis.open("https://email.example/message/CA000kFcWW97r8yg=SsWg7GgCmp
```

## window.name [ = value ]

✓MDN

### [Window/name](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the name of the window.

Can be set, to change the name.

## window.close()

✓MDN

### [Window/close](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Closes the window.

## window.closed

✓MDN

### [Window/closed](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet1.0+Opera Android12.1+

Returns true if the window has been closed, false otherwise.

## `window.stop()`

✓MDN

### [Window/stop](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

---

Opera12.1+Edge79+

Edge (Legacy)14+Internet ExplorerNo

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Cancels the document load.

The `window open steps`, given a string `url`, a string `target`, and a string `features`, are as follows:

1. If the [event loop's termination nesting level](#) is nonzero, return null.
2. Let *source browsing context* be the [entry global object's browsing context](#).
3. If `target` is the empty string, then set `target` to "`_blank`".
4. Let `tokenizedFeatures` be the result of [tokenizing](#) `features`.
5. Let `noopener` and `noreferrer` be false.
6. If `tokenizedFeatures["noopener"]` [exists](#), then:
  1. Set `noopener` to the result of [parsing `tokenizedFeatures\["noopener"\]` as a boolean feature](#).
  2. [Remove](#) `tokenizedFeatures["noopener"]`.
7. If `tokenizedFeatures["noreferrer"]` [exists](#), then:
  1. Set `noreferrer` to the result of [parsing `tokenizedFeatures\["noreferrer"\]` as a boolean feature](#).
  2. [Remove](#) `tokenizedFeatures["noreferrer"]`.
8. If `noreferrer` is true, then set `noopener` to true.

9. Let *target browsing context* and *windowType* be the result of applying [the rules for choosing a browsing context](#) given *target*, *source browsing context*, and *noopener*.

If there is a user agent that supports control-clicking a link to open it in a new tab, and the user control-clicks on an element whose [onclick](#) handler uses the [window.open\(\)](#) API to open a page in an [iframe](#) element, the user agent could override the selection of the target browsing context to instead target a new tab.

10. If *target browsing context* is null, then return null.
11. If *windowType* is either "new and unrestricted" or "new with no opener", then:

1. Set the *target browsing context's is popup* to the result of [checking if a popup window is requested](#), given *tokenizedFeatures*.
2. [Set up browsing context features](#) for *target browsing context* given *tokenizedFeatures*. [\[CSSOMVIEW\]](#)
3. Let *urlRecord* be the [URL record about:blank](#).
4. If *url* is not the empty string, then [parse url](#) relative to the [entry settings object](#), and set *urlRecord* to the [resulting URL record](#), if any. If the [parse a URL](#) algorithm failed, then throw a "[SyntaxError](#)" [DOMException](#).
5. If *urlRecord* [matches about:blank](#), then perform the [URL and history update steps](#) given *target browsing context's active document* and *urlRecord*.

This is necessary in case *url* is something like `about:blank?foo`. If *url* is just plain `about:blank`, this will do nothing.

6. Otherwise:
  1. Let *request* be a new [request](#) whose [URL](#) is *urlRecord*.
  2. If *noreferrer* is true, then set *request's referrer* to "no-referrer".
  3. [Navigate](#) *target browsing context* to *request*, with [exceptionsEnabled](#) set to true, [historyHandling](#) set to "replace", and the [source browsing context](#) set to *source browsing context*.

12. Otherwise:
  1. If *url* is not the empty string, then:
    1. Let *urlRecord* be the [URL record about:blank](#).
    2. [Parse url](#) relative to the [entry settings object](#), and set *urlRecord* to the

[resulting URL record](#), if any. If the [parse a URL](#) algorithm failed, then throw a ["SyntaxError" DOMException](#).

3. Let *request* be a new [request](#) whose [URL](#) is *urlRecord*.
  4. If *noreferrer* is true, then set *request*'s [referrer](#) to "noreferrer".
  5. [Navigate](#) target browsing context to *request*, with [exceptionsEnabled](#) set to true and the [source browsing context](#) set to *source browsing context*.
2. If *noopener* is false, then set *target browsing context*'s [opener browsing context](#) to *source browsing context*.
13. If *noopener* is true or *windowType* is "new with no opener", then return null.
  14. Return *target browsing context*'s [WindowProxy](#) object.

The ***open(url, target, features)*** method on [Window](#) objects provides a mechanism for [navigating](#) an existing [browsing context](#) or opening and navigating an [auxiliary browsing context](#).

When the method is invoked, the user agent must run the [window open steps](#) with *url*, *target*, and *features*.

---

To *tokenize the features argument*:

1. Let *tokenizedFeatures* be a new [ordered map](#).
2. Let *position* point at the first code point of *features*.
3. [While](#) *position* is not past the end of *features*:
  1. Let *name* be the empty string.
  2. Let *value* be the empty string.
  3. [Collect a sequence of code points](#) that are [feature separators](#) from *features* given *position*. This skips past leading separators before the name.
  4. [Collect a sequence of code points](#) that are not [feature separators](#) from *features* given *position*. Set *name* to the collected characters, [converted to ASCII lowercase](#).
  5. Set *name* to the result of [normalizing the feature name](#) *name*.
  6. [While](#) *position* is not past the end of *features* and the code point at *position* in *features* is not U+003D (=):

1. If the code point at *position* in *features* is U+002C (,), or if it is not a [feature separator](#), then [break](#).
2. Advance *position* by 1.

This skips to the first U+003D (=) but does not skip past a U+002C (,) or a non-separator.

7. If the code point at *position* in *features* is a [feature separator](#):
  1. While *position* is not past the end of *features* and the code point at *position* in *features* is a [feature separator](#):
    1. If the code point at *position* in *features* is U+002C (,), then [break](#).
    2. Advance *position* by 1.
- This skips to the first non-separator but does not skip past a U+002C (,).
2. [Collect a sequence of code points](#) that are not [feature separators](#) code points from *features* given *position*. Set *value* to the collected code points, [converted to ASCII lowercase](#).
8. If *name* is not the empty string, then set *tokenizedFeatures[name]* to *value*.

4. Return *tokenizedFeatures*.

To *check if a window feature is set*, given *tokenizedFeatures*, *featureName*, and *defaultValue*:

1. If *tokenizedFeatures[featureName]* [exists](#), then return the result of [parsing tokenizedFeatures\[featureName\] as a boolean feature](#).
2. Return *defaultValue*.

To *check if a popup window is requested*, given *tokenizedFeatures*:

1. If *tokenizedFeatures* is [empty](#), then return false.
2. If *tokenizedFeatures["popup"]* [exists](#), then return the result of [parsing tokenizedFeatures\["popup"\] as a boolean feature](#).
3. Let *location* be the result of [checking if a window feature is set](#), given *tokenizedFeatures*, "location", and false.
4. Let *toolbar* be the result of [checking if a window feature is set](#), given *tokenizedFeatures*, "toolbar", and false.
5. If *location* and *toolbar* are both false, then return true.

6. Let *menubar* be the result of [checking if a window feature is set](#), given *tokenizedFeatures*, "menubar", and false.
7. If *menubar* is false, then return true.
8. Let *resizable* be the result of [checking if a window feature is set](#), given *tokenizedFeatures*, "resizable", and true.
9. If *resizable* is false, then return true.
10. Let *scrollbars* be the result of [checking if a window feature is set](#), given *tokenizedFeatures*, "scrollbars", and false.
11. If *scrollbars* is false, then return true.
12. Let *status* be the result of [checking if a window feature is set](#), given *tokenizedFeatures*, "status", and false.
13. If *status* is false, then return true.
14. Return false.

A code point is a *feature separator* if it is [ASCII whitespace](#), U+003D (=), or U+002C (,).

For legacy reasons, there are some aliases of some feature names. To *normalize a feature name* *name*, switch on *name*:

**"screenx"**

Return "left".

**"screeny"**

Return "top".

**"innerwidth"**

Return "width".

**"innerheight"**

Return "height".

Anything else

Return *name*.

To *parse a boolean feature* given a string *value*:

1. If *value* is the empty string, then return true.
2. If *value* [is](#) "yes", then return true.

- 
3. Let *parsed* be the result of [parsing \*value\* as an integer](#).
  4. If *parsed* is an error, then set it to 0.
  5. Return false if *parsed* is 0, and true otherwise.
- 

The `name` getter steps are:

1. If *this*'s [browsing context](#) is null, then return the empty string.
2. Return *this*'s [browsing context's name](#).

The `name` setter steps are:

1. If *this*'s [browsing context](#) is null, then return.
2. Set *this*'s [browsing context's name](#) to the given value.

The name [gets reset](#) when the browsing context is [navigated](#) to another [origin](#).

---

The `close()` method steps are:

1. Let *current* be *this*'s [browsing context](#).
2. If *current* is null or its [is closing](#) is true, then return.
3. If all the following are true
  - *current* is [script-closable](#)
  - the [incumbent global object](#)'s [browsing context](#) is [familiar with](#) *current*
  - the [incumbent global object](#)'s [browsing context](#) is [allowed to navigate](#) *current*

then:

1. Set *current*'s [is closing](#) to true.
2. [Queue a task](#) on the [DOM manipulation task source](#) to [close](#) *current*.

A [browsing context](#) is *script-closable* if it is an [auxiliary browsing context](#) that was created by a script (as opposed to by an action of the user), or if it is a [top-level browsing context](#) whose [session history](#) contains only one [Document](#).

The `closed` getter steps are to return true if *this*'s [browsing context](#) is null or its [is closing](#) is true; otherwise false.

The `stop()` method steps are to [stop document loading](#) given *this*'s associated [Document](#).

### 7.3.2 Accessing other browsing contexts

#### `window.length`

✓MDN

##### [Window/length](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

Returns the number of [document-tree child browsing contexts](#).

#### `window[index]`

Returns the indicated [document-tree child browsing context](#).

The *number of document-tree child browsing contexts* of a [Window](#) object  $W$  is the result of running these steps:

1. If  $W$ 's [browsing context](#) is null, then return 0.
2. Return the number of [document-tree child browsing contexts](#) of  $W$ 's [browsing context](#).

The `length` getter steps are to return the [number of document-tree child browsing contexts](#) of [this](#).

Indexed access to [document-tree child browsing contexts](#) is defined through the `[[GetOwnProperty]]` internal method of the [WindowProxy](#) object.

### 7.3.3 Named access on the [Window](#) object

#### `window[name]`

Returns the indicated element or collection of elements.

As a general rule, relying on this will lead to brittle code. Which IDs end up mapping to this API can vary over time, as new features are added to the web platform, for example.

Instead of this, use `document.getElementById()` or `document.querySelector()`.

The *document-tree child browsing context name property set* of a [Window](#) object  $window$  is the return value of running these steps:

1. If *window*'s [browsing context](#) is null, then return the empty list.
2. Let *childBrowsingContexts* be all [document-tree child browsing contexts](#) of *window*'s [browsing context](#) whose [browsing context name](#) is not the empty string, in order, and including only the first [document-tree child browsing context](#) with a given [name](#) if multiple [document-tree child browsing contexts](#) have the same one.
3. Remove each [browsing context](#) from *childBrowsingContexts* whose [active document](#)'s [origin](#) is not [same origin](#) with *window*'s [relevant settings object](#)'s [origin](#) and whose [browsing context name](#) does not match the name of its [container](#)'s [name](#) content attribute value.
4. Return the [browsing context names](#) of *childBrowsingContexts*, in the same order.

This means that in the following example, hosted on <https://example.org/>, assuming <https://elsewhere.example/> sets [window.name](#) to "spices", evaluating [window.spices](#) after everything has loaded will yield undefined:

```
<iframe src="https://elsewhere.example.com/"></iframe>
<iframe name="spices"></iframe>
```

The [Window](#) object [supports named properties](#). The [supported property names](#) of a [Window](#) object *window* at any moment consist of the following, in [tree order](#) according to the element that contributed them, ignoring later duplicates:

- *window*'s [document-tree child browsing context name property set](#);
- the value of the [name](#) content attribute for all [embed](#), [form](#), [img](#), and [object](#) elements that have a non-empty [name](#) content attribute and are [in a document tree](#) with *window*'s [associated Document](#) as their [root](#); and
- the value of the [id](#) content attribute for all [HTML elements](#) that have a non-empty [id](#) content attribute and are [in a document tree](#) with *window*'s [associated Document](#) as their [root](#).

To [determine the value of a named property](#) *name* in a [Window](#) object *window*, the user agent must return the value obtained using the following steps:

1. Let *objects* be the list of [named objects](#) of *window* with the name *name*.

There will be at least one such object, by definition.

2. If *objects* contains a [browsing context](#), then return the [WindowProxy](#) object of the [nested browsing context](#) of the first [browsing context container](#) in [tree order](#) whose [nested browsing context](#) is in *objects*.
3. Otherwise, if *objects* has only one element, return that element.

4. Otherwise return an [HTMLCollection](#) rooted at *window*'s [associated Document](#), whose filter matches only [named objects](#) of *window* with the name *name*. (By definition, these will all be elements.)

*Named objects* of [Window](#) object *window* with the name *name*, for the purposes of the above algorithm, consist of the following:

- [document-tree child browsing contexts](#) of *window*'s [associated Document](#) whose [name](#) is *name*;
- [embed](#), [form](#), [img](#), or [object](#) elements that have a [name](#) content attribute whose value is *name* and are [in a document tree](#) with *window*'s [associated Document](#) as their [root](#); and
- [HTML elements](#) that have an [id](#) content attribute whose value is *name* and are [in a document tree](#) with *window*'s [associated Document](#) as their [root](#).

#### 7.3.4 Discarding browsing contexts

To *discard* a [Document](#) *document*:

1. Set *document*'s [salvageable](#) state to false.
2. Run any [unloading document cleanup steps](#) for *document* that are defined by this specification and [other applicable specifications](#).
3. [Abort document](#).
4. Remove any [tasks](#) associated with *document* in any [task source](#), without running those tasks.
5. [Discard](#) all the [child browsing contexts](#) of *document*.
6. For each [session history entry](#) *entry* whose [document](#) is equal to *document*, set *entry*'s [document](#) to null.
7. Set *document*'s [browsing context](#) to null.
8. [Remove](#) *document* from the [owner set](#) of each [WorkerGlobalScope](#) object whose set [contains](#) *document*.
9. [For each](#) *workletGlobalScope* in *document*'s [worklet global scopes](#), [terminate](#) *workletGlobalScope*.

To *discard* a [browsing context](#) *browsingContext*, run these steps:

1. [Discard](#) all [Document](#) objects for all the entries in *browsingContext*'s [session history](#).

2. If *browsingContext* is a [top-level browsing context](#), then [remove](#) *browsingContext*.

User agents may [discard top-level browsing contexts](#) at any time (typically, in response to user requests, e.g., when a user force-closes a window containing one or more [top-level browsing contexts](#)). Other [browsing contexts](#) must be discarded once their [WindowProxy](#) object is eligible for garbage collection, in addition to the other places where this specification requires them to be discarded.

### 7.3.5 Closing browsing contexts

To *close* a *browsing context* *browsingContext*, run these steps:

1. [Prompt to unload](#) *browsingContext*'s [active document](#). If the user [refused to allow the document to be unloaded](#), then return.
2. [Unload](#) *browsingContext*'s [active document](#).
3. Remove *browsingContext* from the user interface (e.g., close or hide its tab in a tabbed browser).
4. [Discard](#) *browsingContext*.

User agents should offer users the ability to arbitrarily [close](#) any [top-level browsing context](#).

### 7.3.6 Browser interface elements

For historical reasons, the [Window](#) interface had some attributes that represented the visibility of certain web browser interface elements.

For privacy and interoperability reasons, those attributes now return values that represent whether the [Window](#)'s [browsing context](#)'s [is popup](#) property is true or false.

Each interface element is represented by a [BarProp](#) object:



#### [BarProp](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 29+

---

Opera 16+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 29+ WebView Android 37+ Samsung Internet 2.0+ Opera Android 16+

```
[Exposed=Window]
interface BarProp {
 readonly attribute boolean visible;
};
```

### [`window.locationbar.visible`](#)

✓MDN

#### [Window/locationbar](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

---

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 14+

### [`window menubar.visible`](#)

✓MDN

#### [Window/menuBar](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

---

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 14+

### [`window.personalbar.visible`](#)

✓MDN

#### [Window/personalbar](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

---

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

### [`window.scrollbars.visible`](#)

✓MDN

#### [Window/scrollbars](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

**window.statusbar.visible**

✓MDN

## [Window/statusbar](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

---

Opera 15+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 14+

**window.toolbar.visible**

✓MDN

## [Window/toolbar](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

---

Opera 15+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 14+

Returns true if the [top-level browsing context](#) is not a popup; otherwise, returns false.

✓MDN

## [BarProp/visible](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 43+

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Opera 30+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 43+ WebView Android 43+ Samsung

Internet 4.0+ Opera Android 30+

The `visible` getter steps are:

1. Let `browsingContext` be [this's relevant global object's browsing context](#).
2. If `browsingContext` is null, then return true.
3. Return the negation of `browsingContext`'s [top-level browsing context's is popup](#).

The following [\*\*BarProp\*\*](#) objects must exist for each [\*\*Window\*\*](#) object:

***The location bar BarProp object***

Historically represented the user interface element that contains a control that displays the browser's location bar.

***The menu bar BarProp object***

Historically represented the user interface element that contains a list of commands in menu form, or some similar interface concept.

***The personal bar BarProp object***

Historically represented the user interface element that contains links to the user's favorite pages, or some similar interface concept.

***The scrollbar BarProp object***

Historically represented the user interface element that contains a scrolling mechanism, or some similar interface concept.

***The status bar BarProp object***

Historically represented a user interface element found immediately below or after the document, as appropriate for the user's media, which typically provides information about ongoing network activity or information about elements that the user's pointing device is currently indicating.

***The toolbar BarProp object***

Historically represented the user interface element found immediately above or before the document, as appropriate for the user's media, which typically provides [session history](#) traversal controls (back and forward buttons, reload buttons, etc.).

The `locationbar` attribute must return [the location bar BarProp object](#).

The `menubar` attribute must return [the menu bar BarProp object](#).

The `personalbar` attribute must return [the personal bar BarProp object](#).

The `scrollbars` attribute must return [the scrollbar BarProp object](#).

The `statusbar` attribute must return [the status bar BarProp object](#).

The `toolbar` attribute must return [the toolbar BarProp object](#).

---

For historical reasons, the `status` attribute on the [Window](#) object must, on getting, return the last string it was set to, and on setting, must set itself to the new value. When the [Window](#) object is created, the attribute must be set to the empty string. It does not do anything else.

### 7.3.7 Script settings for [Window](#) objects

To set up a *window environment settings object*, given a [URL](#) `creationURL`, a [JavaScript execution context](#) `execution context`, null or an [environment](#) `reservedEnvironment`, a [URL](#) `topLevelCreationURL`, and an [origin](#) `topLevelOrigin`, run these steps:

1. Let `realm` be the value of `execution context`'s `Realm` component.
2. Let `window` be `realm`'s [global object](#).
3. Let `settings object` be a new [environment settings object](#) whose algorithms are defined as follows:

The [realm execution context](#)

Return `execution context`.

The [module map](#)

Return the [module map](#) of `window`'s [associated Document](#).

The [responsible document](#)

Return `window`'s [associated Document](#).

The [API URL character encoding](#)

Return the current [character encoding](#) of `window`'s [associated Document](#).

The [API base URL](#)

Return the current [base URL](#) of `window`'s [associated Document](#).

The [origin](#)

Return the [origin](#) of `window`'s [associated Document](#).

The [policy container](#)

Return the [policy container](#) of `window`'s [associated Document](#).

## The [cross-origin isolated capability](#)

Return true if both of the following hold, and false otherwise:

1. *realm's agent cluster's cross-origin-isolation mode* is "[concrete](#)", and
  2. *window's associated Document is allowed to use* the "[cross-origin-isolated](#)" feature.
4. If *reservedEnvironment* is non-null, then:
1. Set *settings object's id* to *reservedEnvironment's id*, [target browsing context](#) to *reservedEnvironment's target browsing context*, and [active service worker](#) to *reservedEnvironment's active service worker*.
  2. Set *reservedEnvironment's id* to the empty string.
- The identity of the reserved environment is considered to be fully transferred to the created [environment settings object](#). The reserved environment is not searchable by the [environment's id](#) from this point on.
5. Otherwise, set *settings object's id* to a new unique opaque string, *settings object's target browsing context* to null, and *settings object's active service worker* to null.
  6. Set *settings object's creation URL* to *creationURL*, *settings object's top-level creation URL* to *topLevelCreationURL*, and *settings object's top-level origin* to *topLevelOrigin*.
  7. Set *realm's [[HostDefined]] field* to *settings object*.

## 7.4 The [WindowProxy](#) exotic object

A [WindowProxy](#) is an exotic object that wraps a [Window](#) ordinary object, indirectiong most operations through to the wrapped object. Each [browsing context](#) has an associated [WindowProxy](#) object. When the [browsing context](#) is [navigated](#), the [Window](#) object wrapped by the [browsing context's associated WindowProxy object](#) is changed.

The [WindowProxy](#) exotic object must use the ordinary internal methods except where it is explicitly specified otherwise below.

There is no [WindowProxy interface object](#).

Every [WindowProxy](#) object has a [\[\[Window\]\]](#) internal slot representing the wrapped [Window](#) object.

Although [WindowProxy](#) is named as a "proxy", it does not do polymorphic dispatch on its target's internal methods as a real proxy would, due to a desire to reuse machinery between [WindowProxy](#) and [Location](#) objects. As long as the [Window](#) object remains an ordinary

object this is unobservable and can be implemented either way.

#### 7.4.1 [[GetPrototypeOf]]( )

1. Let  $W$  be the value of the [\[\[Window\]\]](#) internal slot of **this**.
2. If ! [IsPlatformObjectSameOrigin](#)( $W$ ) is true, then return ! [OrdinaryGetPrototypeOf](#)( $W$ ).
3. Return null.

#### 7.4.2 [[SetPrototypeOf]]( $V$ )

1. Return ! [SetImmutablePrototype](#)(**this**,  $V$ ).

#### 7.4.3 [[IsExtensible]]( )

1. Return true.

#### 7.4.4 [[PreventExtensions]]( )

1. Return false.

#### 7.4.5 [[GetOwnProperty]]( $P$ )

1. Let  $W$  be the value of the [\[\[Window\]\]](#) internal slot of **this**.
2. If  $P$  is an [array index property name](#), then:
  1. Let  $index$  be ! [ToUint32](#)( $P$ ).
  2. Let  $maxProperties$  be the [number of document-tree child browsing contexts](#) of  $W$ .
  3. Let  $value$  be undefined.
  4. If  $maxProperties$  is greater than 0 and  $index$  is less than  $maxProperties$ , then set  $value$  to the [WindowProxy](#) object of the  $index$ th [document-tree child browsing context](#) of  $W$ 's [browsing context](#), sorted in the order that their [browsing context container](#) elements were most recently inserted into  $W$ 's [associated Document](#), the [WindowProxy](#) object of the most recently inserted [browsing context container](#)'s [nested browsing context](#) being last.
  5. If  $value$  is undefined, then:
    1. If ! [IsPlatformObjectSameOrigin](#)( $W$ ) is true, then return undefined.

2. Throw a ["SecurityError" DOMException](#).
  6. Return [PropertyDescriptor](#){ [[Value]]: *value*, [[Writable]]: false, [[Enumerable]]: true, [[Configurable]]: true }.
  3. If ! [IsPlatformObjectSameOrigin](#)(*W*) is true, then return ! [OrdinaryGetOwnProperty](#)(*W*, *P*).  

This is a [willful violation](#) of the JavaScript specification's [invariants of the essential internal methods](#) to maintain compatibility with existing web content. See [tc39/ecma262 issue #672](#) for more information. [\[JAVASCRIPT\]](#)

    4. Let *property* be ! [CrossOriginGetOwnPropertyHelper](#)(*W*, *P*).
    5. If *property* is not undefined, then return *property*.
    6. If *property* is undefined and *P* is in *W*'s [document-tree child browsing context name property set](#), then:
      1. Let *value* be the [WindowProxy](#) object of the [named object](#) of *W* with the name *P*.
      2. Return [PropertyDescriptor](#){ [[Value]]: *value*, [[Enumerable]]: false, [[Writable]]: false, [[Configurable]]: true }.

The reason the property descriptors are non-enumerable, despite this mismatching the same-origin behavior, is for compatibility with existing web content. See [issue #3183](#) for details.
    7. Return ? [CrossOriginPropertyFallback](#)(*P*).
- #### 7.4.6 [[DefineOwnProperty]]( *P, Desc* )
1. Let *W* be the value of the [\[\[Window\]\]](#) internal slot of **this**.
  2. If ! [IsPlatformObjectSameOrigin](#)(*W*) is true, then:
    1. If *P* is an [array index property name](#), return false.
    2. Return ? [OrdinaryDefineOwnProperty](#)( *W, P, Desc* ).

This is a [willful violation](#) of the JavaScript specification's [invariants of the essential internal methods](#) to maintain compatibility with existing web content. See [tc39/ecma262 issue #672](#) for more information. [\[JAVASCRIPT\]](#)
  3. Throw a ["SecurityError" DOMException](#).

#### 7.4.7 [[Get]]( *P, Receiver* )

1. Let *W* be the value of the [\[\[Window\]\]](#) internal slot of **this**.
2. [Check if an access between two browsing contexts should be reported](#), given the [current global object](#)'s [browsing context](#), *W*'s [browsing context](#), *P*, and the [current settings object](#).
3. If ! [IsPlatformObjectSameOrigin](#)( *W* ) is true, then return ? [OrdinaryGet](#)(**this**, *P, Receiver*).
4. Return ? [CrossOriginGet](#)(**this**, *P, Receiver*).

**this** is passed rather than *W* as [OrdinaryGet](#) and [CrossOriginGet](#) will invoke the [\[\[GetOwnProperty\]\]](#) internal method.

#### 7.4.8 [[Set]]( *P, V, Receiver* )

1. Let *W* be the value of the [\[\[Window\]\]](#) internal slot of **this**.
2. [Check if an access between two browsing contexts should be reported](#), given the [current global object](#)'s [browsing context](#), *W*'s [browsing context](#), *P*, and the [current settings object](#).
3. If ! [IsPlatformObjectSameOrigin](#)( *W* ) is true, then:
  1. If *P* is an [array index property name](#), then return false.
  2. Return ? [OrdinarySet](#)( *W, P, V, Receiver* ).
4. Return ? [CrossOriginSet](#)(**this**, *P, V, Receiver*).

**this** is passed rather than *W* as [CrossOriginSet](#) will invoke the [\[\[GetOwnProperty\]\]](#) internal method.

#### 7.4.9 [[Delete]]( *P* )

1. Let *W* be the value of the [\[\[Window\]\]](#) internal slot of **this**.
2. If ! [IsPlatformObjectSameOrigin](#)( *W* ) is true, then:
  1. If *P* is an [array index property name](#), then:
    1. Let *desc* be ! **this**.[\[\[GetOwnProperty\]\]](#)(*P*).
    2. If *desc* is undefined, then return true.

3. Return false.
2. Return ? [OrdinaryDelete](#)( $W, P$ ).
3. Throw a ["SecurityError" DOMException](#).

#### 7.4.10 [[OwnPropertyKeys]]( )

1. Let  $W$  be the value of the [\[\[Window\]\]](#) internal slot of `this`.
2. Let  $keys$  be a new empty [List](#).
3. Let  $maxProperties$  be the [number of document-tree child browsing contexts](#) of  $W$ .
4. Let  $index$  be 0.
5. Repeat while  $index < maxProperties$ ,
  1. Add ! [ToString](#)( $index$ ) as the last element of  $keys$ .
  2. Increment  $index$  by 1.
6. If ! [IsPlatformObjectSameOrigin](#)( $W$ ) is true, then return the concatenation of  $keys$  and ! [OrdinaryOwnPropertyKeys](#)( $W$ ).
7. Return the concatenation of  $keys$  and ! [CrossOriginOwnPropertyKeys](#)( $W$ ).

## 7.5 Origin

Origins are the fundamental currency of the web's security model. Two actors in the web platform that share an origin are assumed to trust each other and to have the same authority. Actors with differing origins are considered potentially hostile versus each other, and are isolated from each other to varying degrees.

For example, if Example Bank's web site, hosted at `bank.example.com`, tries to examine the DOM of Example Charity's web site, hosted at `charity.example.org`, a ["SecurityError" DOMException](#) will be raised.

---

An *origin* is one of the following:

An *opaque origin*

An internal value, with no serialization it can be recreated from (it is serialized as "`null`" per [serialization of an origin](#)), for which the only meaningful operation is testing for equality.

## A *tuple origin*

A [tuple](#) consists of:

- A *scheme* (an [ASCII string](#)).
- A *host* (a [host](#)).
- A *port* (null or a 16-bit unsigned integer).
- A *domain* (null or a [domain](#)). Null unless stated otherwise.

[Origins](#) can be shared, e.g., among multiple [Document](#) objects. Furthermore, [origins](#) are generally immutable. Only the [domain](#) of a [tuple origin](#) can be changed, and only through the [document.domain](#) API.

The effective *domain* of an [origin](#) *origin* is computed as follows:

1. If *origin* is an [opaque origin](#), then return null.
2. If *origin*'s [domain](#) is non-null, then return *origin*'s [domain](#).
3. Return *origin*'s [host](#).

The *serialization* of an *origin* is the string obtained by applying the following algorithm to the given [origin](#) *origin*:

1. If *origin* is an [opaque origin](#), then return "null".
2. Otherwise, let *result* be *origin*'s [scheme](#).
3. Append "://*" to *result*.*
4. Append *origin*'s [host](#), [serialized](#), to *result*.
5. If *origin*'s [port](#) is non-null, append a U+003A COLON character (:), and *origin*'s [port](#), [serialized](#), to *result*.
6. Return *result*.

The [serialization](#) of ("https", "xn--maraa-rta.example", null, null) is "https://xn--maraa-rta.example".

There used to also be a *Unicode serialization of an origin*. However, it was never widely adopted.

---

Two [origins](#), *A* and *B*, are said to be *same origin* if the following algorithm returns true:

1. If *A* and *B* are the same [opaque origin](#), then return true.

2. If  $A$  and  $B$  are both [tuple origins](#) and their [schemes](#), [hosts](#), and [port](#) are identical, then return true.
3. Return false.

Two [origins](#),  $A$  and  $B$ , are said to be *same origin-domain* if the following algorithm returns true:

1. If  $A$  and  $B$  are the same [opaque origin](#), then return true.
2. If  $A$  and  $B$  are both [tuple origins](#), run these substeps:
  1. If  $A$  and  $B$ 's [schemes](#) are identical, and their [domains](#) are identical and non-null, then return true.
  2. Otherwise, if  $A$  and  $B$  are [same origin](#) and their [domains](#) are identical and null, then return true.
3. Return false.

$A$	$B$	<a href="#">same origin</a>	<a href="#">same origin-domain</a>
( <code>https</code> , "example.org", null, null)	( <code>https</code> , "example.org", null, null)	✓	✓
( <code>https</code> , "example.org", 314, null)	( <code>https</code> , "example.org", 420, null)	✗	✗
( <code>https</code> , "example.org", 314, "example.org")	( <code>https</code> , "example.org", 420, "example.org")	✗	✓
( <code>https</code> , "example.org", null, null)	( <code>https</code> , "example.org", null, "example.org")	✓	✗
( <code>https</code> , "example.org", null, "example.org")	( <code>http</code> , "example.org", null, "example.org")	✗	✗

### 7.5.1 Sites

A *scheme-and-host* is a [tuple](#) of an [ASCII string](#) and a [host](#).

A *site* is an [opaque origin](#) or a [scheme-and-host](#).

To obtain a *site*, given an origin *origin*, run these steps:

1. If *origin* is an [opaque origin](#), then return *origin*.
2. If *origin*'s [host's registrable domain](#) is null, then return (*origin*'s [scheme](#), *origin*'s [host](#)).
3. Return (*origin*'s [scheme](#), *origin*'s [host's registrable domain](#)).

The *serialization of a site* is the string obtained by applying the following algorithm to the

given [site](#) *site*:

1. If *site* is an [opaque origin](#), then return "null".
2. Let *result* be *site*[0].
3. Append ":"// to *result*.
4. Append *site*[1], [serialized](#), to *result*.
5. Return *result*.

It needs to be clear from context that the serialized value is a site, not an origin, as there is not necessarily a syntactic difference between the two. For example, the origin ("https", "shop.example", null, null) and the site ("https", "shop.example") have the same serialization: "https://shop.example".

Two [origins](#), *A* and *B*, are said to be *schemelessly same site* if the following algorithm returns true:

1. If *A* and *B* are the same [opaque origin](#), then return true.
2. If *A* and *B* are both [tuple origins](#), then:
  1. Let *hostA* be *A*'s [host](#), and let *hostB* be *B*'s [host](#).
  2. If *hostA* [equals](#) *hostB* and *hostA*'s [registerable domain](#) is null, then return true.
  3. If *hostA*'s [registerable domain equals](#) *hostB*'s [registerable domain](#) and is non-null, then return true.
3. Return false.

Two [origins](#), *A* and *B*, are said to be *same site* if both of the following statements are true:

- *A* and *B* are [schemelessly same site](#)
- *A* and *B* are either both [opaque origins](#), or both [tuple origins](#) with the same [scheme](#)

Unlike the [same origin](#) and [same origin-domain](#) concepts, for [schemelessly same site](#) and [same site](#), the [port](#) and [domain](#) components are ignored.

For the reasons [explained in URL](#), the [same site](#) and [schemelessly same site](#) concepts should be avoided when possible, in favor of [same origin](#) checks.

Given that `wildlife.museum`, `museum`, and `com` are [public suffixes](#) and that `example.com` is not:

<i>A</i>	<i>B</i>	<u>schemelessly same site</u>	<u>same site</u>
(“https”, “example.com”)	(“https”, “sub.example.com”)	✓	✓
(“https”, “example.com”)	(“https”, “sub.other.example.com”)	✓	✓
(“https”, “example.com”)	(“http”, “non- secure.example.com”)	✓	✗
(“https”, “r.wildlife.museum”)	(“https”, “sub.r.wildlife.museum”)	✓	✓
(“https”, “r.wildlife.museum”)	(“https”, “sub.other.r.wildlife.museum”)	✓	✓
(“https”, “r.wildlife.museum”)	(“https”, “other.wildlife.museum”)	✗	✗
(“https”, “r.wildlife.museum”)	(“https”, “wildlife.museum”)	✗	✗
(“https”, “wildlife.museum”)	(“https”, “wildlife.museum”)	✓	✓

(Here we have omitted the [port](#) and [domain](#) components since they are not considered.)

### 7.5.2 Relaxing the same-origin restriction



#### [Document/domain](#)

Support in all current engines.

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Firefox 1+ Safari 1+ Chrome 1+

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Opera 12.1+ Edge 79+

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Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

**`document.domain [ = domain ]`**

Returns the current domain used for security checks.

Can be set to a value that removes subdomains, to change the [origin’s domain](#) to allow pages on other subdomains of the same domain (if they do the same thing) to access each other. This enables pages on different hosts of a domain to synchronously access each other’s DOMs.

In sandboxed [iframes](#), [Documents](#) with [opaque origins](#), [Documents](#) without a [browsing context](#), and when the “[document-domain](#)” feature is disabled, the setter will throw a

"[SecurityError](#)" exception. In cases where [crossOriginIsolated](#) or [originAgentCluster](#) return true, the setter will do nothing.

Avoid using the [document.domain](#) setter. It undermines the security protections provided by the same-origin policy. This is especially acute when using shared hosting; for example, if an untrusted third party is able to host an HTTP server at the same IP address but on a different port, then the same-origin protection that normally protects two different sites on the same host will fail, as the ports are ignored when comparing origins after the [document.domain](#) setter has been used.

Because of these security pitfalls, this feature is in the process of being removed from the web platform. (This is a long process that takes many years.)

Instead, use [postMessage\(\)](#) or [MessageChannel](#) objects to communicate across origins in a safe manner.

The [domain](#) getter steps are:

1. Let *effectiveDomain* be [this's origin's effective domain](#).
2. If *effectiveDomain* is null, then return the empty string.
3. Return *effectiveDomain*, [serialized](#).

The [domain](#) setter steps are:

1. If [this's browsing context](#) is null, then throw a "[SecurityError](#)" [DOMException](#).
2. If [this's active sandboxing flag set](#) has its [sandboxed document.domain browsing context flag](#) set, then throw a "[SecurityError](#)" [DOMException](#).
3. If [this](#) is not [allowed to use](#) the "[document-domain](#)" feature, then throw a "[SecurityError](#)" [DOMException](#).
4. Let *effectiveDomain* be [this's origin's effective domain](#).
5. If *effectiveDomain* is null, then throw a "[SecurityError](#)" [DOMException](#).
6. If the given value [is not a registrable domain suffix of](#) and [is not equal to](#) *effectiveDomain*, then throw a "[SecurityError](#)" [DOMException](#).
7. If the [surrounding agent's agent cluster's is origin-keyed](#) is true, then return.
8. Set [this's origin's domain](#) to the result of [parsing](#) the given value.

To determine if a string *hostSuffixString* is a registrable domain suffix of or is equal to a [host originalHost](#), run these steps:

1. If *hostSuffixString* is the empty string, then return false.
2. Let *hostSuffix* be the result of [parsing](#) *hostSuffixString*.
3. If *hostSuffix* is failure, then return false.
4. If *hostSuffix* does not [equal](#) *originalHost*, then:
  1. If *hostSuffix* or *originalHost* is not a [domain](#), then return false.  
This excludes [hosts](#) that are [IP addresses](#).
  2. If *hostSuffix*, prefixed by U+002E (.), does not match the end of *originalHost*, then return false.
  3. If one of the following is true
    - *hostSuffix* [equals](#) *hostSuffix*'s [public suffix](#)
    - *hostSuffix*, prefixed by U+002E (.), matches the end *originalHost*'s [public suffix](#)
 then return false. [\[URL\]](#)
  4. Assert: *originalHost*'s [public suffix](#), prefixed by U+002E (.), matches the end of *hostSuffix*.
5. Return true.

<i>hostSuffixString</i>	<i>originalHost</i>	Outcome of <a href="#">is a registerable domain suffix of or is equal to</a>
"0.0.0.0"	0.0.0.0	✓
"0x10203"	0.1.2.3	✓
"[0::1]"	::1	✓
"example.com"	example.com	✓
"example.com"	example.com.	✗
"example.com."	example.com	✗
"example.com"	www.example.com	✓
"com"	example.com	✗
"example"	example	✓

Trailing  
At the t  
public s

"compute.amazonaws.com"	example.compute.amazonaws.com	✗	At the t
"example.compute.amazonaws.com"	www.example.compute.amazonaws.com	✗	*.com is a pub
"amazonaws.com"	www.example.compute.amazonaws.com	✗	At the t
"amazonaws.com"	test.amazonaws.com	✓	amazon registra

### 7.5.3 Origin-keyed agent clusters

#### `window.originAgentCluster`

Returns true if this [Window](#) belongs to an [agent cluster](#) which is [origin-keyed](#), in the manner described in this section.

A [Document](#) delivered over a [secure context](#) can request that it be placed in an [origin-keyed agent cluster](#), by using the '[Origin-Agent-Cluster](#)' HTTP response header. This header is a [structured header](#) whose value must be a [boolean](#). [\[STRUCTURED-FIELDS\]](#)

Per the processing model in the [create and initialize a new Document object](#), values that are not the [structured header boolean](#) true value (i.e., '?1') will be ignored.

The consequences of using this header are that the resulting [Document](#)'s [agent cluster key](#) is its [origin](#), instead of the [corresponding site](#). In terms of observable effects, this means that attempting to [relax the same-origin restriction](#) using [document.domain](#) will instead do nothing, and it will not be possible to send [WebAssembly.Module](#) objects to cross-origin [Documents](#) (even if they are [same site](#)). Behind the scenes, this isolation can allow user agents to allocate implementation-specific resources corresponding to [agent clusters](#), such as processes or threads, more efficiently.

Note that within a [browsing context group](#), the '[Origin-Agent-Cluster](#)' header can never cause same-origin [Document](#) objects to end up in different [agent clusters](#), even if one sends the header and the other doesn't. This is prevented by means of the [historical agent cluster key map](#).

This means that the [originAgentCluster](#) getter can return false, even if the header is set, if the header was omitted on a previously-loaded same-origin page in the same [browsing context group](#). Similarly, it can return true even when the header is not set.

The [originAgentCluster](#) getter steps are to return the [surrounding agent](#)'s [agent cluster](#)'s [is origin-keyed](#).

[Document](#)s with an [opaque origin](#) can be considered unconditionally origin-keyed; for them the header has no effect, and the [originAgentCluster](#) getter will always return true.

Similarly, [Document](#)s whose [agent cluster](#)'s [cross-origin isolation mode](#) is not "[none](#)" are automatically origin-keyed. The '[Origin-Agent-Cluster](#)' header might be useful as an

additional hint to implementations about resource allocation, since the '[Cross-Origin-Opener-Policy](#)' and '[Cross-Origin-Embedder-Policy](#)' headers used to achieve cross-origin isolation are more about ensuring that everything in the same address space opts in to being there. But adding it would have no additional observable effects on author code.

## 7.6 Sandboxing

A *sandboxing flag set* is a set of zero or more of the following flags, which are used to restrict the abilities that potentially untrusted resources have:

### The *sandboxed navigation browsing context flag*

This flag [prevents content from navigating browsing contexts other than the sandboxed browsing context itself](#) (or browsing contexts further nested inside it), [auxiliary browsing contexts](#) (which are protected by the [sandboxed auxiliary navigation browsing context flag](#) defined next), and the [top-level browsing context](#) (which is protected by the [sandboxed top-level navigation without user activation browsing context flag](#) and [sandboxed top-level navigation with user activation browsing context flag](#) defined below).

If the [sandboxed auxiliary navigation browsing context flag](#) is not set, then in certain cases the restrictions nonetheless allow popups (new [top-level browsing contexts](#)) to be opened. These [browsing contexts](#) always have *one permitted sandboxed navigator*, set when the browsing context is created, which allows the [browsing context](#) that created them to actually navigate them. (Otherwise, the [sandboxed navigation browsing context flag](#) would prevent them from being navigated even if they were opened.)

### The *sandboxed auxiliary navigation browsing context flag*

This flag [prevents content from creating new auxiliary browsing contexts](#), e.g. using the [target](#) attribute or the [window.open\(\)](#) method.

### The *sandboxed top-level navigation without user activation browsing context flag*

This flag [prevents content from navigating their top-level browsing context](#) and [prevents content from closing their top-level browsing context](#). It is consulted only when the sandboxed browsing context's [active window](#) does not have [transient activation](#).

When the [sandboxed top-level navigation without user activation browsing context flag](#) is *not* set, content can navigate its [top-level browsing context](#), but other [browsing contexts](#) are still protected by the [sandboxed navigation browsing context flag](#) and possibly the [sandboxed auxiliary navigation browsing context flag](#).

### The *sandboxed top-level navigation with user activation browsing context flag*

This flag [prevents content from navigating their top-level browsing context](#) and [prevents content from closing their top-level browsing context](#). It is consulted only when the sandboxed browsing context's [active window](#) has [transient activation](#).

As with the [sandboxed top-level navigation without user activation](#) browsing context flag, this flag only affects the [top-level browsing context](#); if it is not set, other [browsing contexts](#) might still be protected by other flags.

#### The *sandboxed plugins* browsing context flag

This flag prevents content from instantiating [plugins](#), whether using [the embed element](#), [the object element](#), or through [navigation](#) of their [nested browsing context](#).

#### The *sandboxed origin* browsing context flag

This flag [forces content into a unique origin](#), thus preventing it from accessing other content from the same [origin](#).

This flag also [prevents script from reading from or writing to the document.cookie IDL attribute](#), and blocks access to [localStorage](#).

#### The *sandboxed forms* browsing context flag

This flag [blocks form submission](#).

#### The *sandboxed pointer lock* browsing context flag

This flag disables the Pointer Lock API. [\[POINTERLOCK\]](#)

#### The *sandboxed scripts* browsing context flag

This flag [blocks script execution](#).

#### The *sandboxed automatic features* browsing context flag

This flag blocks features that trigger automatically, such as [automatically playing a video](#) or [automatically focusing a form control](#).

#### The *sandboxed document.domain* browsing context flag

This flag prevents content from using the [document.domain](#) setter.

#### The *sandbox propagates to auxiliary* browsing contexts flag

This flag prevents content from escaping the sandbox by ensuring that any [auxiliary browsing context](#) it creates inherits the content's [active sandboxing flag set](#).

#### The *sandboxed modals* flag

This flag prevents content from using any of the following features to produce modal dialogs:

- `window.alert()`
- `window.confirm()`
- `window.print()`
- `window.prompt()`
- the `beforeunload` event

The *sandboxed orientation lock browsing context flag*

This flag disables the ability to lock the screen orientation. [\[SCREENORIENTATION\]](#)

The *sandboxed presentation browsing context flag*

This flag disables the Presentation API. [\[PRESENTATION\]](#)

The *sandboxed downloads browsing context flag*

This flag prevents content from initiating or instantiating downloads, whether through [downloading hyperlinks](#) or through [navigation](#) that gets handled [as a download](#).

When the user agent is to *parse a sandboxing directive*, given a string *input*, a [sandboxing flag set](#) *output*, it must run the following steps:

1. [Split \*input\* on ASCII whitespace](#), to obtain *tokens*.
2. Let *output* be empty.
3. Add the following flags to *output*:
  - The [sandboxed navigation browsing context flag](#).
  - The [sandboxed auxiliary navigation browsing context flag](#), unless *tokens* contains the *allow-popups* keyword.
  - The [sandboxed top-level navigation without user activation browsing context flag](#), unless *tokens* contains the *allow-top-navigation* keyword.
  - The [sandboxed top-level navigation with user activation browsing context flag](#), unless *tokens* contains either the *allow-top-navigation-by-user-activation* keyword or the [allow-top-navigation](#) keyword.

This means that if the [allow-top-navigation](#) is present, the [allow-top-navigation-by-user-activation](#) keyword will have no effect. For this reason, specifying both is a document conformance error.

- The [sandboxed plugins browsing context flag](#).
- The [sandboxed origin browsing context flag](#), unless the *tokens* contains the *allow-same-origin* keyword.

The [allow-same-origin](#) keyword is intended for two cases.

First, it can be used to allow content from the same site to be sandboxed to disable scripting, while still allowing access to the DOM of the sandboxed content.

Second, it can be used to embed content from a third-party site, sandboxed to prevent that site from opening popups, etc, without preventing the embedded page from communicating back to its originating site, using the database APIs to store data, etc.

- The [sandboxed forms browsing context flag](#), unless *tokens* contains the **allow-forms** keyword.
- The [sandboxed pointer lock browsing context flag](#), unless *tokens* contains the **allow-pointer-lock** keyword.
- The [sandboxed scripts browsing context flag](#), unless *tokens* contains the **allow-scripts** keyword.
- The [sandboxed automatic features browsing context flag](#), unless *tokens* contains the **allow-scripts** keyword (defined above).

This flag is relaxed by the same keyword as scripts, because when scripts are enabled these features are trivially possible anyway, and it would be unfortunate to force authors to use script to do them when sandboxed rather than allowing them to use the declarative features.

- The [sandboxed document.domain browsing context flag](#).
- The [sandbox propagates to auxiliary browsing contexts flag](#), unless *tokens* contains the **allow-popups-to-escape-sandbox** keyword.
- The [sandboxed modals flag](#), unless *tokens* contains the **allow-modals** keyword.
- The [sandboxed orientation lock browsing context flag](#), unless *tokens* contains the **allow-orientation-lock** keyword.
- The [sandboxed presentation browsing context flag](#), unless *tokens* contains the **allow-presentation** keyword.
- The [sandboxed downloads browsing context flag](#), unless *tokens* contains the **allow-downloads** keyword.

set. When a browsing context is created, its popup sandboxing flag set must be empty. It is populated by the rules for choosing a browsing context and the obtain a browsing context to use for a navigation response algorithm.

Every iframe element has an iframe sandboxing flag set, which is a sandboxing flag set. Which flags in an iframe sandboxing flag set are set at any particular time is determined by the iframe element's sandbox attribute.

Every Document has an active sandboxing flag set, which is a sandboxing flag set. When the Document is created, its active sandboxing flag set must be empty. It is populated by the navigation algorithm.

Every resource that is obtained by the navigation algorithm has a forced sandboxing flag set, which is a sandboxing flag set. A resource by default has no flags set in its forced sandboxing flag set, but other specifications can define that certain flags are set.

In particular, the forced sandboxing flag set is used by *Content Security Policy*. [CSP]

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To determine the creation sandboxing flags for a browsing context browsing context, given null or an element embedder, return the union of the flags that are present in the following sandboxing flag sets:

- If embedder is null, then: the flags set on browsing context's popup sandboxing flag set.
- If embedder is an element, then: the flags set on embedder's iframe sandboxing flag set.
- If embedder is an element, then: the flags set on embedder's node document's active sandboxing flag set.

After creation, the sandboxing flags for a browsing context browsing context are the result of determining the creation sandboxing flags given browsing context and browsing context's container.

## 7.7 Cross-origin opener policies

A cross-origin opener policy value allows a document which is navigated to in a top-level browsing context to force the creation of a new top-level browsing context, and a corresponding group. The possible values are:

**"unsafe-none"**

This is the (current) default and means that the document will occupy the same top-level browsing context as its predecessor, unless that document specified a different cross-origin opener policy.

## **"same-origin-allow-popups"**

This forces the creation of a new [top-level browsing context](#) for the document, unless its predecessor specified the same [cross-origin opener policy](#) and they are [same origin](#).

## **"same-origin"**

This behaves the same as "[same-origin-allow-popups](#)", with the addition that any [auxiliary browsing context](#) created needs to contain [same origin](#) documents that also have the same [cross-origin opener policy](#) or it will appear closed to the opener.

## **"same-origin-plus-COEP"**

This behaves the same as "[same-origin](#)", with the addition that it sets the (new) [top-level browsing context](#)'s [group](#)'s [cross-origin isolation mode](#) to one of "[logical](#)" or "[concrete](#)".

"[same-origin-plus-COEP](#)" cannot be directly set via the '[Cross-Origin-Opener-Policy](#)' header, but results from a combination of setting both '[Cross-Origin-Opener-Policy: same-origin](#)' and a '[Cross-Origin-Embedder-Policy](#)' header whose value is [compatible with cross-origin isolation](#) together.

A *cross-origin opener policy* consists of:

- A *value*, which is a [cross-origin opener policy value](#), initially "[unsafe-none](#)".
- A *reporting endpoint*, which is string or null, initially null.
- A *report-only value*, which is a [cross-origin opener policy value](#), initially "[unsafe-none](#)".
- A *report-only reporting endpoint*, which is a string or null, initially null.

To *match cross-origin opener policy values*, given a [cross-origin opener policy value](#) *A*, an [origin](#) *originA*, a [cross-origin opener policy value](#) *B*, and an [origin](#) *originB*:

1. If *A* is "[unsafe-none](#)" and *B* is "[unsafe-none](#)", then return true.
2. If *A* is "[unsafe-none](#)" or *B* is "[unsafe-none](#)", then return false.
3. If *A* is *B* and *originA* is [same origin](#) with *originB*, then return true.
4. Return false.

### 7.7.1 The headers

A [Document](#)'s [cross-origin opener policy](#) is derived from the '[Cross-Origin-Opener-](#)

`'Policy'` and `'Cross-Origin-Opener-Policy-Report-Only'` HTTP response headers. These headers are [structured headers](#) whose value must be a [token](#). [\[STRUCTURED-FIELDS\]](#)

The valid [token](#) values are the [opener policy values](#). The token may also have attached [parameters](#); of these, the `"report-to"` parameter can have a [valid URL string](#) identifying an appropriate reporting endpoint. [\[REPORTING\]](#)

Per the processing model described below, user agents will ignore this header if it contains an invalid value. Likewise, user agents will ignore this header if the value cannot be parsed as a [token](#).

---

To obtain a cross-origin opener policy given a [response](#) response and an [environment](#) `reservedEnvironment`:

1. Let `policy` be a new [cross-origin opener policy](#).
2. If `reservedEnvironment` is a [non-secure context](#), then return `policy`.
3. Let `value` be the result of [getting a structured field value](#) given `'Cross-Origin-Opener-Policy'` and `"item"` from `response`'s [header list](#).
4. If `parsedItem` is not null, then:
  1. If `parsedItem[0]` is `"same-origin"`, then:
    1. Let `coep` be the result of [obtaining a cross-origin embedder policy](#) from `response` and `reservedEnvironment`.
    2. If `coep`'s `value` is [compatible with cross-origin isolation](#), then set `policy`'s `value` to `"same-origin-plus-COEP"`.
    3. Otherwise, set `policy`'s `value` to `"same-origin"`.
  2. If `parsedItem[0]` is `"same-origin-allow-popups"`, then set `policy`'s `value` to `"same-origin-allow-popups"`.
  3. If `parsedItem[1][report-to]` exists and it is a string, then set `policy`'s [reporting endpoint](#) to `parsedItem[1][report-to]`.
5. Set `parsedItem` to the result of [getting a structured field value](#) given `'Cross-Origin-Opener-Policy-Report-Only'` and `"item"` from `response`'s [header list.](#)
6. If `parsedItem` is not null, then:
  1. If `parsedItem[0]` is `"same-origin"`, then:

1. Let *coep* be the result of [obtaining a cross-origin embedder policy](#) from *response* and *reservedEnvironment*.
2. If *coep*'s [value](#) is [compatible with cross-origin isolation](#) or *coep*'s [report-only value](#) is [compatible with cross-origin isolation](#), then set *policy*'s [report-only value](#) to "[same-origin-plus-COEP](#)".

Report only COOP also considers report-only COEP to assign the special "[same-origin-plus-COEP](#)" value. This allows developers more freedom in the order of deployment of COOP and COEP.

3. Otherwise, set *policy*'s [report-only value](#) to "[same-origin](#)".
2. If *parsedItem*[0] is "[same-origin-allow-popups](#)", then set *policy*'s [report-only value](#) to "[same-origin-allow-popups](#)".
3. If *parsedItem*[1][["report-to"](#)] [exists](#) and it is a string, then set *policy*'s [report-only reporting endpoint](#) to *parsedItem*[1][["report-to"](#)].

7. Return *policy*.

### 7.7.2 Browsing context group switches due to cross-origin opener policy

To check if COOP values require a browsing context group switch, given a boolean *isInitialAboutBlank*, two [origins](#) *responseOrigin* and *activeDocumentNavigationOrigin*, and two [cross-origin opener policy values](#) *responseCOOPValue* and *activeDocumentCOOPValue*:

1. If the result of [matching](#) *activeDocumentCOOPValue*, *activeDocumentNavigationOrigin*, *responseCOOPValue*, and *responseOrigin* is true, return false.
2. If all of the following are true:
  - *isInitialAboutBlank*,
  - *activeDocumentCOOPValue*'s [value](#) is "[same-origin-allow-popups](#)".
  - *responseCOOPValue* is "[unsafe-none](#)",

then return false.

3. Return true.

To check if enforcing report-only COOP would require a browsing context group switch, given a boolean *isInitialAboutBlank*, two [origins](#) *responseOrigin*, *activeDocumentNavigationOrigin*, and two [cross-origin opener policies](#) *responseCOOP* and *activeDocumentCOOP*:

1. If the result of [checking if COOP values require a browsing context group switch](#) given `isInitialAboutBlank`, `responseOrigin`, `activeDocumentNavigationOrigin`, `responseCOOP's report-only value` and `activeDocumentCOOPReportOnly's report-only value` is false, then return false.

Matching report-only policies allows a website to specify the same report-only cross-origin opener policy on all its pages and not receive violation reports for navigations between these pages.

2. If the result of [checking if COOP values require a browsing context group switch](#) given `isInitialAboutBlank`, `responseOrigin`, `activeDocumentNavigationOrigin`, `responseCOOP's value` and `activeDocumentCOOPReportOnly's report-only value` is true, then return true.
3. If the result of [checking if COOP values require a browsing context group switch](#) given `isInitialAboutBlank`, `responseOrigin`, `activeDocumentNavigationOrigin`, `responseCOOP's report-only value` and `activeDocumentCOOPReportOnly's value` is true, then return true.
4. Return false.

A *cross-origin opener policy enforcement result* is a [struct](#) with the following [items](#):

- A boolean *needs a browsing context group switch*, initially false.
- A boolean *would need a browsing context group switch due to report-only*, initially false.
- A [URL](#) *url*.
- An [origin](#) *origin*.
- A [cross-origin opener policy](#) *cross-origin opener policy*.
- A boolean *current context is navigation source*.

To enforce a response's cross-origin opener policy, given a [browsing context](#) `browsingContext`, a [URL](#) `responseURL`, an [origin](#) `responseOrigin`, a [cross-origin opener policy](#) `responseCOOP`, a [cross-origin opener policy enforcement result](#) `currentCOOPEnforcementResult`, and a [referrer](#) `referrer`:

1. Let `newCOOPEnforcementResult` be a new [cross-origin opener policy enforcement result](#) whose [needs a browsing context group switch](#) is `currentCOOPEnforcementResult's needs a browsing context group switch`, [would need a browsing context group switch due to report-only](#) is `currentCOOPEnforcementResult's would need a browsing context group switch due to report-only`, `url` is `responseURL`, `origin` is `responseOrigin`, `coop` is `responseCOOP`, and [current context is navigation source](#) is true.

2. Let *isInitialAboutBlank* be true if *browsingContext* is [still on its initial about:blank Document](#); otherwise, false.
3. If *isInitialAboutBlank* is true and *browsingContext*'s [initial URL](#) is null, set *browsingContext*'s [initial URL](#) to *responseURL*.
4. If the result of [checking if COOP values require a browsing context group switch](#) given *isInitialAboutBlank*, *currentCOOPEnforcementResult*'s [cross-origin opener policy's value](#), *currentCOOPEnforcementResult*'s [origin](#), *responseCOOP*'s [value](#), and *responseOrigin* is true, then:
  1. Set *newCOOPEnforcementResult*'s [needs a browsing context group switch](#) to true.
  2. If *browsingContext*'s [group](#)'s [browsing context set](#)'s [size](#) is greater than 1, then:
    1. [Queue a violation report for browsing context group switch when navigating to a COOP response with responseCOOP, "enforce", responseURL, currentCOOPEnforcementResult's url, currentCOOPEnforcementResult's origin, responseOrigin, and referrer.](#)
    2. [Queue a violation report for browsing context group switch when navigating away from a COOP response with currentCOOPEnforcementResult's cross-origin opener policy, "enforce", currentCOOPEnforcementResult's url, responseURL, currentCOOPEnforcementResult's origin, responseOrigin, and currentCOOPEnforcementResult's current context is navigation source.](#)
5. If the result of [checking if enforcing report-only COOP would require a browsing context group switch](#) given *isInitialAboutBlank*, *responseOrigin*, *currentCOOPEnforcementResult*'s [origin](#), *responseCOOP*, and *currentCOOPEnforcementResult*'s [cross-origin opener policy](#), is true, then:
  1. Set *result*'s [would need a browsing context group switch due to report-only](#) to true.
  2. If *browsingContext*'s [group](#)'s [browsing context set](#)'s [size](#) is greater than 1, then:
    1. [Queue a violation report for browsing context group switch when navigating to a COOP response with responseCOOP, "reporting", responseURL, currentCOOPEnforcementResult's url, currentCOOPEnforcementResult's origin, responseOrigin, and referrer.](#)
    2. [Queue a violation report for browsing context group switch when navigating away from a COOP response with currentCOOPEnforcementResult's cross-origin opener policy, "reporting", currentCOOPEnforcementResult's url, responseURL,](#)

*currentCOOPEnforcementResult's [origin](#), responseOrigin, and currentCOOPEnforcementResult's [current context is navigation source](#).*

6. Return *newCOOPEnforcementResult*.

To obtain a browsing context to use for a navigation response, given a [browsing contexts](#) *browsingContext*, a [sandboxing flag set](#) *sandboxFlags*, a [cross-origin opener policy](#) *navigationCOOP*, and a [cross-origin opener policy enforcement result](#) *coopEnforcementResult*:

1. Assert: *browsingContext* is a [top-level browsing context](#).
2. If *coopEnforcementResult*'s [needs a browsing context group switch](#) is false, then:
  1. If *coopEnforcementResult*'s [would need a browsing context group switch due to report-only](#) is true, set *browsing context*'s [virtual browsing context group ID](#) to a new unique identifier.
  2. Return *browsingContext*.
3. Let *newBrowsingContext* be the result of [creating a new top-level browsing context](#).
4. If *navigationCOOP*'s [value](#) is "[same-origin-plus-COEP](#)", then set *newBrowsingContext*'s [group](#)'s [cross-origin isolation mode](#) to either "[logical](#)" or "[concrete](#)". The choice of which is [implementation-defined](#).
- It is difficult on some platforms to provide the security properties required by the [cross-origin isolated capability](#). "[concrete](#)" grants access to it and "[logical](#)" does not.
5. If *sandboxFlags* is not empty, then:
  1. Assert *navigationCOOP*'s [value](#) is "[unsafe-none](#)".
  2. Assert: *newBrowsingContext*'s [popup sandboxing flag set](#) is empty.
  3. Set *newBrowsingContext*'s [popup sandboxing flag set](#) to a [clone](#) of *sandboxFlags*.
6. [Discard](#) *browsingContext*.

This has no effect on *browsingContext*'s [group](#), unless *browsingContext* was its sole [top-level browsing context](#). In that case, the user agent might delete the [browsing context group](#) which no longer contains any [browsing contexts](#).

7. Return *newBrowsingContext*.

The impact of swapping browsing context groups following a navigation is not fully defined. It is currently under discussion in [issue #5350](#).

### 7.7.3 Reporting

An *accessor-accessed relationship* is an enum that describes the relationship between two [browsing contexts](#) between which an access happened. It can take the following values:

#### *accessor is opener*

The accessor [browsing context](#) or one of its [ancestors](#) is the [opener browsing context](#) of the accessed [browsing context's top-level browsing context](#).

#### *accessor is openee*

The accessed [browsing context](#) or one of its [ancestors](#) is the [opener browsing context](#) of the accessor [browsing context's top-level browsing context](#).

#### *none*

There is no opener relationship between the accessor [browsing context](#), the accessor [browsing context](#), or any of their [ancestors](#).

To *check if an access between two browsing contexts should be reported*, given two [browsing contexts](#) accessor and accessed, a JavaScript property name  $P$ , and an [environment settings object environment](#):

1. If  $P$  is not a [cross-origin accessible window property name](#), then return.
2. If accessor's [active document](#)'s [origin](#) or any of its [ancestors' active document](#)'s [origins](#) are not [same origin](#) with accessor's [top-level browsing context's active document](#)'s [origin](#), or if accessed's [active document](#)'s [origin](#) or any of its [ancestors' active document](#)'s [origins](#) are not [same origin](#) with accessed's [top-level browsing context's active document](#)'s [origin](#), then return.

This avoids leaking information about cross-origin iframes to a top level frame with cross-origin opener policy reporting.

3. If accessor's [top-level browsing context's virtual browsing context group ID](#) is accessed's [top-level browsing context's virtual browsing context group ID](#), then return.
4. Let  $accessorAccessedRelationship$  be a new [accessor-accessed relationship](#) with value [none](#).
5. If accessed's [top-level browsing context's opener browsing context](#) is accessor or an [ancestor](#) of accessor, then set  $accessorAccessedRelationship$  to [accessor is opener](#).
6. If accessor's [top-level browsing context's opener browsing context](#) is accessed or an [ancestor](#) of accessed, then set  $accessorAccessedRelationship$  to [accessor is openee](#).
7. [Queue violation reports for accesses](#), given  $accessorAccessedRelationship$ , accessor's [top-](#)

level browsing context's active document's cross-origin opener policy, accessed's top-level browsing context's active document's cross-origin opener policy, accessor's active document's URL, accessed's active document's URL, accessor's top-level browsing context's initial URL, accessed's top-level browsing context's initial URL, accessor's active document's origin, accessed's active document's origin, accessor's top-level browsing context's opener origin at creation, accessed's top-level browsing context's opener origin at creation, accessor's top-level browsing context's active document's referrer, accessed's top-level browsing context's active document's referrer,  $P$ , and environment.

To sanitize a URL to send in a report given a URL url:

1. Let sanitizedURL be a copy of url.
2. Set the username given sanitizedURL and the empty string.
3. Set the password given sanitizedURL and the empty string.
4. Return the serialization of sanitizedURL with exclude fragment set to true.

To queue a violation report for browsing context group switch when navigating to a COOP response given a cross-origin opener policy coop, a string disposition, a URL coopURL, a URL previousResponseURL, two origins coopOrigin and previousResponseOrigin, and a referrer referrer:

1. If coop's reporting endpoint is null, return.
2. Let coopValue be coop's value.
3. If disposition is "reporting", then set coopValue to coop's report-only value.
4. Let serializedReferrer be an empty string.
5. If referrer is a URL, set serializedReferrer to the serialization of referrer.
6. Let body be a new object containing the following properties:

key	value
disposition	disposition
effectivePolicy	coopValue
previousResponseURL	If coopOrigin and previousResponseOrigin are same origin this is the sanitization of previousResponseURL, null otherwise.
referrer	serializedReferrer
type	"navigation-to-response"

7. Queue body as "coop" for coop's reporting endpoint with coopURL.

To queue a violation report for browsing context group switch when navigating away from a COOP response given a [cross-origin opener policy](#) coop, a string disposition, a [URL](#) coopURL, a [URL](#) nextResponseURL, two [origins](#) coopOrigin and nextResponseOrigin, and a boolean isCOOPResponseNavigationSource:

1. If coop's [reporting endpoint](#) is null, return.
2. Let coopValue be coop's [value](#).
3. If disposition is "reporting", then set coopValue to coop's [report-only value](#).
4. Let body be a new object containing the following properties:

key	value
disposition	<i>disposition</i>
effectivePolicy	<i>coopValue</i> If coopOrigin and nextResponseOrigin are <a href="#">same origin</a> or nextResponseURL isCOOPResponseNavigationSource is true, this is the <a href="#">sanitization</a> of previousResponseURL, null otherwise.
type	"navigation-from-response"

5. [Queue](#) body as "coop" for coop's [reporting endpoint](#) with coopURL.

To queue violation reports for accesses, given an [accessor-accessed relationship](#) accessorAccessedRelationship, two [cross-origin opener policies](#) accessorCOOP and accessedCOOP, four [URLs](#) accessorURL, accessedURL, accessorInitialURL, accessedInitialURL, four [origins](#) accessorOrigin, accessedOrigin, accessorCreatorOrigin and accessedCreatorOrigin, two [referrers](#) accessorReferrer and accessedReferrer, a string propertyName, and an [environment settings object](#) environment:

1. If coop's [reporting endpoint](#) is null, return.
2. Let coopValue be coop's [value](#).
3. If disposition is "reporting", then set coopValue to coop's [report-only value](#).
4. If accessorAccessedRelationship is [accessor is opener](#):
  1. [Queue a violation report for access to an opened window](#), given accessorCOOP, accessorURL, accessedURL, accessedInitialURL, accessorOrigin, accessedOrigin, accessedCreatorOrigin, propertyName, and environment.
  2. [Queue a violation report for access from the opener](#), given accessedCOOP, accessedURL, accessorURL, accessedOrigin, accessorOrigin, propertyName, and accessedReferrer.
5. Otherwise, if accessorAccessedRelationship is [accessor is openee](#):

1. [Queue a violation report for access to the opener](#), given `accessorCOOP`, `accessorURL`, `accessedURL`, `accessorOrigin`, `accessedOrigin`, `propertyName`, `accessorReferrer`, and `environment`.
  2. [Queue a violation report for access from an opened window](#), given `accessedCOOP`, `accessedURL`, `accessorURL`, `accessorInitialURL`, `accessedOrigin`, `accessorOrigin`, `accessorCreatorOrigin`, and `propertyName`.
6. Otherwise:
1. [Queue a violation report for access to another window](#), given `accessorCOOP`, `accessorURL`, `accessedURL`, `accessorOrigin`, `accessedOrigin`, `propertyName`, and `environment`
  2. [Queue a violation report for access from another window](#), given `accessedCOOP`, `accessedURL`, `accessorURL`, `accessedOrigin`, `accessorOrigin`, and `propertyName`.

To queue a violation report for access to the opener, given a [cross-origin opener policy](#) `coop`, two [URLs](#) `coopURL` and `openerURL`, two [origins](#) `coopOrigin` and `openerOrigin`, a string `propertyName`, a [referrer](#) `referrer`, and an [environment settings object](#) `environment`:

1. Let `sourceFile`, `lineNumber` and `columnNumber` be the relevant script URL and problematic position which triggered this report.
2. Let `serializedReferrer` be an empty string.
3. If `referrer` is a [URL](#), set `serializedReferrer` to the [serialization](#) of `referrer`.
4. Let `body` be a new object containing the following properties:

key	value
<code>disposition</code>	<code>"reporting"</code>
<code>effectivePolicy</code>	<code>coop's report-only value</code>
<code>property</code>	<code>propertyName</code>
<code>openerURL</code>	If <code>coopOrigin</code> and <code>openerOrigin</code> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <code>openerURL</code> , null otherwise.
<code>referrer</code>	<code>serializedReferrer</code>
<code>sourceFile</code>	<code>sourceFile</code>
<code>lineNumber</code>	<code>lineNumber</code>
<code>columnNumber</code>	<code>columnNumber</code>
<code>type</code>	<code>"access-to-opener"</code>

5. [Queue body as "coop"](#) for `coop's reporting endpoint` with `coopURL` and `environment`.

To queue a violation report for access to an opened window, given a [cross-origin opener policy](#) `coop`, three [URLs](#) `coopURL`, `openedWindowURL` and `initialWindowURL`, three [origins](#) `coopOrigin`, `openedWindowOrigin`, and `openerInitialOrigin`, a string `propertyName`, and an

[environment settings object](#) *environment*:

1. Let *sourceFile*, *lineNumber* and *columnNumber* be the relevant script URL and problematic position which triggered this report.
2. Let *body* be a new object containing the following properties:

key	value
disposition	"reporting"
effectivePolicy	<i>coop's report-only value</i>
property	<i>propertyName</i>
openedWindowURL	If <i>coopOrigin</i> and <i>openedWindowOrigin</i> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <i>openedWindowURL</i> , null otherwise.
openedWindowInitialURL	If <i>coopOrigin</i> and <i>openerInitialOrigin</i> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <i>initialWindowURL</i> , null otherwise.
sourceFile	<i>sourceFile</i>
lineNumber	<i>lineNumber</i>
columnNumber	<i>columnNumber</i>
type	"access - to - opener"

3. [Queue](#) *body* as "**coop**" for *coop's reporting endpoint* with *coopURL* and *environment*.

To queue a violation report for access to another window, given a [cross-origin opener policy](#) *coop*, two [URLs](#) *coopURL* and *otherURL*, two [origins](#) *coopOrigin* and *otherOrigin*, a string *propertyName*, and an [environment settings object](#) *environment*:

1. Let *sourceFile*, *lineNumber* and *columnNumber* be the relevant script URL and problematic position which triggered this report.
2. Let *body* be a new object containing the following properties:

key	value
disposition	"reporting"
effectivePolicy	<i>coop's report-only value</i>
property	<i>propertyName</i>
otherURL	If <i>coopOrigin</i> and <i>otherOrigin</i> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <i>otherURL</i> , null otherwise.
sourceFile	<i>sourceFile</i>
lineNumber	<i>lineNumber</i>
columnNumber	<i>columnNumber</i>
type	"access - to - opener"

3. [Queue](#) *body* as "**coop**" for *coop's reporting endpoint* with *coopURL* and *environment*.

To queue a violation report for access from the opener, given a [cross-origin opener policy](#) *coop*,

two [URLs](#) `coopURL` and `openerURL`, two [origins](#) `coopOrigin` and `openerOrigin`, a string `propertyName`, and a [referrer](#) `referrer`:

1. If `coop`'s [reporting endpoint](#) is null, return.
2. Let `serializedReferrer` be an empty string.
3. If `referrer` is a [URL](#), set `serializedReferrer` to the [serialization](#) of `referrer`.
4. Let `body` be a new object containing the following properties:

key	value
<code>disposition</code>	<code>"reporting"</code>
<code>effectivePolicy</code>	<code>coop</code> 's <a href="#">report-only value</a>
<code>property</code>	<code>propertyName</code>
<code>openerURL</code>	If <code>coopOrigin</code> and <code>openerOrigin</code> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <code>openerURL</code> , null otherwise.
<code>referrer</code>	<code>serializedReferrer</code>
<code>type</code>	<code>"access-to-opener"</code>

5. [Queue](#) `body` as "`coop`" for `coop`'s [reporting endpoint](#) with `coopURL`.

To queue a violation report for access from an opened window, given a [cross-origin opener policy](#) `coop`, three [URLs](#) `coopURL`, `openedWindowURL` and `initialWindowURL`, three [origins](#) `coopOrigin`, `openedWindowOrigin`, and `openerInitialOrigin`, and a string `propertyName`:

1. If `coop`'s [reporting endpoint](#) is null, return.
2. Let `body` be a new object containing the following properties:

key	value
<code>disposition</code>	<code>"reporting"</code>
<code>effectivePolicy</code>	<code>coopValue</code>
<code>property</code>	<code>coop</code> 's <a href="#">report-only value</a>
<code>openedWindowURL</code>	If <code>coopOrigin</code> and <code>openedWindowOrigin</code> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <code>openedWindowURL</code> , null otherwise.
<code>openedWindowInitialURL</code>	If <code>coopOrigin</code> and <code>openerInitialOrigin</code> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <code>initialWindowURL</code> , null otherwise.
<code>type</code>	<code>"access-to-opener"</code>

3. [Queue](#) `body` as "`coop`" for `coop`'s [reporting endpoint](#) with `coopURL`.

To queue a violation report for access from another window, given a [cross-origin opener policy](#) `coop`, two [URLs](#) `coopURL` and `otherURL`, two [origins](#) `coopOrigin` and `otherOrigin`, and a string `propertyName`:

1. If *coop*'s [reporting endpoint](#) is null, return.
2. Let *body* be a new object containing the following properties:

key	value
disposition	<b>"reporting"</b>
effectivePolicy	<i>coop</i> 's <a href="#">report-only value</a>
property	<i>propertyName</i>
otherURL	If <i>coopOrigin</i> and <i>otherOrigin</i> are <a href="#">same origin</a> , this is the <a href="#">sanitization</a> of <i>otherURL</i> , null otherwise.
type	<b>access-to-opener</b>

3. [Queue](#) *body* as "coop" for *coop*'s [reporting endpoint](#) with *coopURL*.

## 7.8 Cross-origin embedder policies



### [Headers/Cross-Origin-Embedder-Policy](#)

Support in all current engines.

Firefox 79+ Safari iOS preview+ Chrome 83+

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Opera 69+ Edge 83+

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Edge (Legacy) No Internet Explorer No

---

Firefox Android 79+ Safari iOS No Chrome Android 83+ WebView Android 86+ Samsung Internet 13.0+ Opera Android 59+

An *embedder policy value* is one of three strings that controls the fetching of cross-origin resources without explicit permission from resource owners.

#### **"unsafe-none"**

This is the default value. When this value is used, cross-origin resources can be fetched without giving explicit permission through the [CORS protocol](#) or the '[Cross-Origin-Resource-Policy](#)' header.

#### **"require-corp"**

When this value is used, fetching cross-origin resources requires the server's explicit permission through the [CORS protocol](#) or the '[Cross-Origin-Resource-Policy](#)' header.

#### **"credentialless"**

When this value is used, fetching cross-origin no-CORS resources omits credentials. In

exchange, an explicit '[Cross-Origin-Resource-Policy](#)' header is not required. Other requests sent with credentials require the server's explicit permission through the [CORS protocol](#) or the '[Cross-Origin-Resource-Policy](#)' header.

Before supporting "[credentialless](#)", implementers are strongly encouraged to support both:

- [Private Network Access](#)
- [Opaque Response Blocking](#)

Otherwise, it would allow attackers to leverage the client's network position to read non public resources, using the [cross-origin isolated capability](#).

An [embedder policy value](#) is *compatible with cross-origin isolation* if it is "[credentialless](#)" or "[require-corp](#)".

An *embedder policy* consists of:

- A *value*, which is an [embedder policy value](#), initially "[unsafe-none](#)".
- A *reporting endpoint* string, initially the empty string.
- A *report only value*, which is an [embedder policy value](#), initially "[unsafe-none](#)".
- A *report only reporting endpoint* string, initially the empty string.

The "[coep](#)" report type is a [report type](#) whose value is "[coep](#)". It is [visible to ReportingObservers](#).

### 7.8.1 The headers

The '[Cross-Origin-Embedder-Policy](#)' and '[Cross-Origin-Embedder-Policy-Report-Only](#)' HTTP response headers allow a server to declare an [embedder policy](#) for an [environment settings object](#). These headers are [structured headers](#) whose values must be [token](#). [\[STRUCTURED-FIELDS\]](#)

The valid [token](#) values are the [embedder policy values](#). The token may also have attached [parameters](#); of these, the "[report-to](#)" parameter can have a [valid URL string](#) identifying an appropriate reporting endpoint. [\[REPORTING\]](#)

The [processing model](#) fails open (by defaulting to "[unsafe-none](#)") in the presence of a header that cannot be parsed as a token. This includes inadvertent lists created by combining multiple instances of the '[Cross-Origin-Embedder-Policy](#)' header present in a given response:

<a href="#">'Cross-Origin-Embedder-Policy'</a>	Final <a href="#">embedder policy value</a>
No header delivered	" <a href="#">unsafe-none</a> "
' <a href="#">require-corp</a> '	" <a href="#">require-corp</a> "

**'Cross-Origin-Embedder-Policy'** Final embedder policy value  
'unknown-value' "unsafe-none"  
'require-corp, unknown-value' "unsafe-none"  
'unknown-value, unknown-value' "unsafe-none"  
'unknown-value, require-corp' "unsafe-none"  
'require-corp, require-corp' "unsafe-none"

(The same applies to '[Cross-Origin-Embedder-Policy-Report-Only](#)').

---

To obtain an embedder policy from a [response](#) response and an [environment](#) environment:

1. Let *policy* be a new [embedder policy](#).
2. If *environment* is a [non-secure context](#), then return *policy*.
3. Let *parsedItem* be the result of [getting a structured field value](#) with '[Cross-Origin-Embedder-Policy](#)' and "item" from *response*'s [header list](#).
4. If *parsedItem* is non-null and *parsedItem[0]* is [compatible with cross-origin isolation](#):
  1. Set *policy*'s [value](#) to *parsedItem[0]*.
  2. If *parsedItem[1][report-to]* exists, then set *policy*'s [endpoint](#) to *parsedItem[1][report-to]*.
5. Set *parsedItem* to the result of [getting a structured field value](#) with '[Cross-Origin-Embedder-Policy-Report-Only](#)' and "item" from *response*'s [header list](#).
6. If *parsedItem* is non-null and *parsedItem[0]* is [compatible with cross-origin isolation](#):
  1. Set *policy*'s [value](#) to *parsedItem[0]*.
  2. If *parsedItem[1][report-to]* exists, then set *policy*'s [endpoint](#) to *parsedItem[1][report-to]*.
7. Return *policy*.

## 7.8.2 Embedder policy checks

To check a navigation response's adherence to its embedder policy given a [response](#) response, a [browsing context](#) target, and an [embedder policy](#) *responsePolicy*:

1. If *target* is not a [child browsing context](#), then return true.
2. Let *parentPolicy* be *target*'s [container document](#)'s [policy container](#)'s [embedder policy](#).

3. If *parentPolicy*'s [report-only value](#) is [compatible with cross-origin isolation](#) and *responsePolicy*'s [value](#) is not, then [queue a cross-origin embedder policy inheritance violation](#) with *response*, "navigation", *parentPolicy*'s [report only reporting endpoint](#), "reporting", and target's [container document's relevant settings object](#).
4. If *parentPolicy*'s [value](#) is not [compatible with cross-origin isolation](#) or *responsePolicy*'s [value](#) is [compatible with cross-origin isolation](#), then return true.
5. [Queue a cross-origin embedder policy inheritance violation](#) with *response*, "navigation", *parentPolicy*'s [reporting endpoint](#), "enforce", and target's [container document's relevant settings object](#).
6. Return false.

To check a global object's embedder policy given a [WorkerGlobalScope](#) *workerGlobalScope*, an [environment settings object](#) *owner*, and a [response](#) *response*:

1. If *workerGlobalScope* is not a [DedicatedWorkerGlobalScope](#) object, then return true.
2. Let *policy* be *workerGlobalScope*'s [embedder policy](#).
3. Let *ownerPolicy* be *owner*'s [policy container](#)'s embedder policy.
4. If *ownerPolicy*'s [report-only value](#) is [compatible with cross-origin isolation](#) and *policy*'s [value](#) is not, then [queue a cross-origin embedder policy inheritance violation](#) with *response*, "worker initialization", *owner*'s [policy](#)'s [report only reporting endpoint](#), "reporting", and *owner*.
5. If *ownerPolicy*'s [value](#) is not [compatible with cross-origin isolation](#) or *policy*'s [value](#) is [compatible with cross-origin isolation](#), then return true.
6. [Queue a cross-origin embedder policy inheritance violation](#) with *response*, "worker initialization", *owner*'s [policy](#)'s [reporting endpoint](#), "enforce", and *owner*.
7. Return false.

To queue a cross-origin embedder policy inheritance violation given a [response](#) *response*, a string *type*, a string *endpoint*, a string *disposition*, and an [environment settings object](#) *settings*:

1. Let *serialized* be the result of [serializing a response URL for reporting](#) with *response*.
2. Let *body* be a new object containing the following properties:

key	value
type	<i>type</i>
blockedURL	<i>serialized</i>

key	value
disposition	<i>disposition</i>

3. Queue *body* as the "[coep](#)" report type for *endpoint* on *settings*.

## 7.9 Policy containers

A *policy container* is a [struct](#) containing policies that apply to a [Document](#), a [WorkerGlobalScope](#), or a [WorkletGlobalScope](#). It has the following [items](#):

- A *CSP list*, which is a [CSP list](#). It is initially empty.
- An *embedder policy*, which is an [embedder policy](#). It is initially a new [embedder policy](#).
- A *referrer policy*, which is a [referrer policy](#). It is initially the [default referrer policy](#).

Move other policies into the policy container.

To *clone* a *policy container* given a [policy container](#) *policyContainer*:

1. Let *clone* be a new [policy container](#).
2. For each *policy* in *policyContainer*'s [CSP list](#), append a copy of *policy* into *clone*'s [CSP list](#).
3. Set *clone*'s [embedder policy](#) to a copy of *policyContainer*'s [embedder policy](#).
4. Set *clone*'s [referrer policy](#) to *policyContainer*'s [referrer policy](#).
5. Return *clone*.

To determine whether a [URL](#) *url* requires storing the policy container in history:

1. If *url*'s [scheme](#) is "blob", then return false.
2. If *url* is [about:srcdoc](#), then return false.
3. If *url* [is local](#), then return true.
4. Return false.

To create a *policy container* from a *fetch response* given a [response](#) *response* and an [environment-or-null environment](#):

1. If *response*'s [URL](#)'s [scheme](#) is "blob", then return a [clone](#) of *response*'s [URL](#)'s blob URL entry's [environment](#)'s [policy container](#).
2. Let *result* be a new [policy container](#).

3. Set *result*'s [CSP list](#) to the result of [parsing a response's Content Security Policies](#) given *response*.
4. If *environment* is non-null, then set *result*'s [embedder policy](#) to the result of [obtaining an embedder policy](#) given *response* and *environment*. Otherwise, set it to "[unsafe-none](#)".
5. Set *result*'s [referrer policy](#) to the result of [parsing the 'Referrer-Policy' header](#) given *response*. [\[REFERRERPOLICY\]](#)
6. Return *result*.

To determine *navigation params policy container* given a [URL](#) *responseURL* and four [policy container](#)-or-nulls *historyPolicyContainer*, *initiatorPolicyContainer*, *parentPolicyContainer*, and *responsePolicyContainer*:

1. If *historyPolicyContainer* is not null, then:
  1. Assert: *responseURL* [requires storing the policy container in history](#).
  2. Return a [clone](#) of *historyPolicyContainer*.
2. If *responseURL* is [about:srcdoc](#), then:
  1. Assert: *parentPolicyContainer* is not null.
  2. Return a [clone](#) of *parentPolicyContainer*.
3. If *responseURL* [is local](#) and *initiatorPolicyContainer* is not null, then return a [clone](#) of *initiatorPolicyContainer*.
4. If *responsePolicyContainer* is not null, then return *responsePolicyContainer*.
5. Return a new [policy container](#).

To *initialize a worker global scope's policy container* given a [WorkerGlobalScope](#) *workerGlobalScope*, a [response](#) *response*, and an [environment](#) *environment*:

1. If *workerGlobalScope*'s [url is local](#) but its [scheme](#) is not "[blob](#)":
  1. Assert: *workerGlobalScope*'s [owner set](#)'s [size](#) is 1.
  2. Set *workerGlobalScope*'s [policy container](#) to a [clone](#) of *workerGlobalScope*'s [owner set](#)[0]'s [relevant settings object](#)'s [policy container](#).
2. Otherwise, set *workerGlobalScope*'s [policy container](#) to the result of [creating a policy container from a fetch response](#) given *response* and *environment*.

## 7.10 Session history and navigation

### 7.10.1 Browsing sessions

A *browsing session* is .... See [whatwg/html issue #4782](#) and [whatwg/html issue #5350](#) for defining [browsing session](#). It is roughly analogous to a [top-level browsing context](#) except that it cannot be replaced due to a '[Cross-Origin-Opener-Policy](#)' header or navigation.

A [top-level browsing context](#) has an associated *browsing session* which is a [browsing session](#).

The *browsing session* of an [environment settings object](#) *environment* is the result of running these steps:

1. Assert: *environment* has a [responsible document](#).
2. Return *environment*'s [responsible document](#)'s [browsing context](#)'s [top-level browsing context](#)'s [browsing session](#).

### 7.10.2 The session history of browsing contexts

The sequence of [Document](#)s in a [browsing context](#) is its *session history*. Each [browsing context](#), including [child browsing contexts](#), has a distinct session history. A [browsing context](#)'s session history consists of a flat list of [session history entries](#).

Each [Document](#) object in a [browsing context](#)'s [session history](#) is associated with a unique [History](#) object which must all model the same underlying [session history](#).

The *history* getter steps are to return [this](#)'s associated [Document](#)'s [History](#) instance.

---

A *session history entry* is a [struct](#) with the following [items](#):

- *URL*, a [URL](#)
- *document*, a [Document](#) or null

Each entry, when first created, has a [Document](#) for its [document](#). However, when a [Document](#) is not [active](#), it's possible for it to be [discarded](#) to free resources. The [URL](#) and other data in the [session history entry](#) is then used to bring a new [Document](#) into being to take the place of the original, in the case where the user agent finds itself having to navigate to the entry.

- *serialized state*, which is [serialized state](#) or null, initially null
- *policy container*, a [policy container](#) or null
- *scroll restoration mode*, a [scroll restoration mode](#), initially "[auto](#)"

- *scroll position data*, which is scroll position data for the [document](#)'s [restorable scrollable regions](#)
- *browsing context name*, a [browsing context name](#) or null, initially null
- *persisted user state*, which is [implementation-defined](#), initially null

For example, some user agents might want to persist the values of form controls.

User agents that persist the value of form controls are encouraged to also persist their directionality (the value of the element's [dir](#) attribute). This prevents values from being displayed incorrectly after a history traversal when the user had originally entered the values with an explicit, non-default directionality.

[Serialized state](#) is a serialization (via [StructuredSerializeForStorage](#)) of an object representing a user interface state. We sometimes informally refer to "state objects", which are the objects representing user interface state supplied by the author, or alternately the objects created by deserializing (via [StructuredDeserialize](#)) serialized state.

Pages can [add serialized state](#) to the session history. These are then [deserialized](#) and [returned to the script](#) when the user (or script) goes back in the history, thus enabling authors to use the "navigation" metaphor even in one-page applications.

[Serialized state](#) is intended to be used for two main purposes: first, storing a pre-parsed description of the state in the [URL](#) so that in the simple case an author doesn't have to do the parsing (though one would still need the parsing for handling [URLs](#) passed around by users, so it's only a minor optimization). Second, so that the author can store state that one wouldn't store in the URL because it only applies to the current [Document](#) instance and it would have to be reconstructed if a new [Document](#) were opened.

An example of the latter would be something like keeping track of the precise coordinate from which a popup [div](#) was made to animate, so that if the user goes back, it can be made to animate to the same location. Or alternatively, it could be used to keep a pointer into a cache of data that would be fetched from the server based on the information in the [URL](#), so that when going back and forward, the information doesn't have to be fetched again.

A *scroll restoration mode* indicates whether the user agent should restore the persisted scroll position (if any) when traversing to an [entry](#). A scroll restoration mode is one of the following:

#### **"auto"**

The user agent is responsible for restoring the scroll position upon navigation.

#### **"manual"**

The page is responsible for restoring the scroll position and the user agent does not attempt to do so automatically

Several contiguous entries in a session history can share the same [document](#). This can occur

when the initial entry is reached via normal [navigation](#), and the following entry is added via [`history.pushState\(\)`](#). Or it can occur via [navigation to a fragment](#).

All entries that share the same [document](#) (and that are therefore merely different states of one particular document) are contiguous by definition.

User agents may [discard](#) the [documents](#) of entries with non-null [documents](#), as long as the following conditions are met:

- They must not discard the [document](#) of the [current entry](#).
- They must not discard any [Document](#) objects which are referenced from script.

Apart from these restrictions, this standard does not specify when user agents should discard an entry's [document](#), versus keeping it cached.

[Discarding a Document](#) will set the corresponding [document](#) item of any [session history entries](#) to null. Subsequent navigations to those entries will result in the creation of a new [Document](#) object, and set the [document](#) item to it.

---

At any point, one of the entries in the session history is the *current entry*. This is the entry representing the [active document](#) of the [browsing context](#). Which entry is the [current entry](#) is changed by the algorithms defined in this specification, e.g., during [session history traversal](#).

The [current entry](#) is usually the initial entry created upon navigation. However, it can also be one of the contiguous entries that share the same [document](#), as described above.

Each [Document](#) in a [browsing context](#) can also have a *latest entry*. This is the entry for that [Document](#) to which the [browsing context](#)'s [session history](#) was most recently traversed. When a [Document](#) is created, it initially has no [latest entry](#).

### 7.10.3 The [History](#) interface



#### [History](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 3+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

## Window/history

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

```
enum ScrollRestoration { "auto", "manual" };
```

```
[Exposed=Window]
interface History {
 readonly attribute unsigned long length;
 attribute ScrollRestoration scrollRestoration;
 readonly attribute any state;
 undefined go(optional long delta = 0);
 undefined back();
 undefined forward();
 undefined pushState(any data, DOMString unused, optional USVString? url = null);
 undefined replaceState(any data, DOMString unused, optional USVString? url = null);
};
```

### window.history.length

✓MDN

## History/length

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the number of entries in the [joint session history](#).

### window.history.scrollRestoration [ = value ]

✓MDN

## History/scrollRestoration

Support in all current engines.

Firefox46+Safari11+Chrome46+

---

Opera33+Edge79+

---

Edge (Legacy)NoInternet ExplorerNo

---

Firefox Android46+Safari iOS11+Chrome Android46+WebView Android46+Samsung Internet5.0+Opera Android33+

Returns the [scroll restoration mode](#) of the current entry in the [session history](#).

Can be set, to change the [scroll restoration mode](#) of the current entry in the [session history](#).

## [`window.history.state`](#)

✓MDN

### [History/state](#)

Support in all current engines.

Firefox4+Safari6+Chrome19+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS6+Chrome Android25+WebView Android37+Samsung Internet1.5+Opera Android12.1+

Returns the current [serialized state](#), deserialized into an object.

## [`window.history.go\(\[ delta \]\)`](#)

✓MDN

### [History/go](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Goes back or forward the specified number of steps in the [joint session history](#).

A zero delta will reload the current page.

If the delta is out of range, does nothing.

## [`window.history.back\(\)`](#)

✓MDN

## [History/back](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Goes back one step in the [joint session history](#).

If there is no previous page, does nothing.

## [window.history.forward\(\)](#)

✓MDN

## [History/forward](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Goes forward one step in the [joint session history](#).

If there is no next page, does nothing.

`window.history.pushState(data, "")`

✓MDN

[History/pushState](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 4+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11.5+

Push a new entry into session history with the given *data* associated. The current entry's URL will be copied over and used for the new entry's URL.

(The second parameter exists for historical reasons, and cannot be omitted; passing the empty string is traditional.)

`window.history.pushState(data, "", url)`

Push a new entry into session history with the given *data* associated, and with its URL set to *url*.

If the current [Document](#) cannot have its URL rewritten to *url*, a "[SecurityError](#)" [DOMException](#) will be thrown.

(The second parameter exists for historical reasons, and cannot be omitted; passing the empty string is traditional.)

`window.history.replaceState(data, "")`

✓MDN

[History/replaceState](#)

Support in all current engines.

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 4+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11.5+

Updates the data stored in the current session history entry to *data*.

(The second parameter exists for historical reasons, and cannot be omitted; passing the

empty string is traditional.)

## `window.history.replaceState(data, "", url)`

Updates the data stored in the current session history entry to *data*, and its URL to *url*.

If the current [Document](#) cannot have its URL rewritten to *url*, a "[SecurityError](#)" [DOMException](#) will be thrown.

(The second parameter exists for historical reasons, and cannot be omitted; passing the empty string is traditional.)

The *joint session history* of a [top-level browsing context](#) is the union of all the [session histories](#) of all [browsing contexts](#) of all the [fully active Document](#) objects that share that [top-level browsing context](#), with all the entries that are [current entries](#) in their respective [session histories](#) removed except for the [current entry of the joint session history](#).

The *current entry of the joint session history* is the entry that most recently became a [current entry](#) in its [session history](#).

Entries in the [joint session history](#) are ordered chronologically by the time they were added to their respective [session histories](#). Each entry has an index; the earliest entry has index 0, and the subsequent entries are numbered with consecutively increasing integers (1, 2, 3, etc.).

Since each [Document](#) in a [browsing context](#) might have a different [event loop](#), the actual state of the [joint session history](#) can be somewhat nebulous. For example, two sibling [iframe](#) elements could both [traverse](#) from one unique origin to another at the same time, so their precise order might not be well-defined; similarly, since they might only find out about each other later, they might disagree about the length of the [joint session history](#).

Each [History](#) object has *state*, initially null.

The *length* getter steps are:

1. If `this`'s associated [Document](#) is not [fully active](#), then throw a "[SecurityError](#)" [DOMException](#).
2. Return the number of entries in the [top-level browsing context's joint session history](#).

The actual entries are not accessible from script.

The *scrollRestoration* getter steps are:

1. If `this`'s associated [Document](#) is not [fully active](#), then throw a "[SecurityError](#)" [DOMException](#).
2. Return `this`'s [session history's current entry's scroll restoration mode](#).

The `scrollRestoration` setter steps are:

1. If `this`'s associated `Document` is not `fully active`, then throw a "`SecurityError`" `DOMException`.
2. Set `this`'s `session history`'s `current entry`'s `scroll restoration mode` to the given value.

The `state` getter steps are:

1. If `this`'s associated `Document` is not `fully active`, then throw a "`SecurityError`" `DOMException`.
2. Return `this`'s `state`.

The `go(delta)` method steps are:

1. Let `document` be `this`'s associated `Document`.
2. If `document` is not `fully active`, then throw a "`SecurityError`" `DOMException`.
3. If `delta` is 0, then act as if the `location.reload()` method was called, and return.
4. Traverse the history by a delta with `delta` and `document`'s `browsing context`.

The `back()` method steps are:

1. Let `document` be `this`'s associated `Document`.
2. If `document` is not `fully active`, then throw a "`SecurityError`" `DOMException`.
3. Traverse the history by a delta with `-1` and `document`'s `browsing context`.

The `forward()` method steps are:

1. Let `document` be `this`'s associated `Document`.
2. If `document` is not `fully active`, then throw a "`SecurityError`" `DOMException`.
3. Traverse the history by a delta with `+1` and `document`'s `browsing context`.

---

Each `top-level browsing context` has a `session history traversal queue`, initially empty, to which tasks can be added.

Each `top-level browsing context`, when created, must begin running the following algorithm, known as the `session history event loop` for that `top-level browsing context`, in parallel:

1. Wait until this `top-level browsing context`'s `session history traversal queue` is not empty.

2. Pull the first [task](#) from this [top-level browsing context's session history traversal queue](#), and execute it.
3. Return to the first step of this algorithm.

The [session history event loop](#) helps coordinate cross-browsing-context transitions of the [joint session history](#): since each [browsing context](#) might, at any particular time, have a different [event loop](#) (this can happen if the user navigates from `example.com` to `shop.example`), transitions would otherwise have to involve cross-event-loop synchronization.

---

To *traverse the history by a delta* given *delta* and [browsing context source browsing context](#), the user agent must append a [task](#) to this [top-level browsing context's session history traversal queue](#), the [task](#) consisting of running the following steps:

1. If the index of the [current entry of the joint session history](#) plus *delta* is less than zero or greater than or equal to the number of items in the [joint session history](#), then return.
2. Let *specified entry* be the entry in the [joint session history](#) whose index is the sum of *delta* and the index of the [current entry of the joint session history](#).
3. Let *specified browsing context* be the [browsing context](#) of the *specified entry*.
4. If *source browsing context* is not [allowed to navigate](#) *specified browsing context*, then return.
5. If the *specified browsing context*'s [active document](#)'s [unload counter](#) is greater than 0, then return.
6. [Queue a global task](#) on the [history traversal task source](#) given *specified browsing context*'s [active window](#) to perform the following steps:
  1. If there is an ongoing attempt to navigate *specified browsing context* that has not yet [matured](#) (i.e. it has not passed the point of making its [Document](#) the [active document](#)), then cancel that attempt to navigate the [browsing context](#).
  2. If the *specified browsing context*'s [active document](#) is not the same [Document](#) as the [Document](#) of the *specified entry*, then run these substeps:
    1. [Prompt to unload](#) the [active document](#) of the *specified browsing context*. If the user [refused to allow the document to be unloaded](#), then return.
    2. [Unload the active document](#) of the *specified browsing context*.
  3. [Traverse the history](#) of the *specified browsing context* to the *specified entry* with [explicitHistoryNavigation](#) set to true.

When the user navigates through a [browsing context](#), e.g. using a browser's back and forward

buttons, the user agent must [traverse the history by a delta](#) with a delta equivalent to the action specified by the user and the browsing context being operated on.

---

The *URL and history update steps*, given a [Document](#) document, a [URL](#) newURL, an optional [serialized state](#)-or-null serializedData (default null), and an optional boolean isPush (default false), are:

1. Let *browsingContext* be *document*'s [browsing context](#).
2. If *isPush* is true, then:
  1. Remove all the entries in *browsingContext*'s [session history](#) after the [current entry](#). If the [current entry](#) is the last entry in the session history, then no entries are removed.

This [doesn't necessarily have to affect](#) the user agent's user interface.
  2. Remove any [tasks](#) queued by the [history traversal task source](#) that are associated with any [Document](#) objects in the [top-level browsing context](#)'s [document family](#).
  3. [Save persisted state](#) to the [current entry](#).
  4. Add a [session history entry](#) entry to *browsingContext*'s [session history](#), after the [current entry](#), with
    - *newURL* as the [URL](#);
    - *document* as the [document](#);
    - *serializedData* as the [serialized state](#);
    - the [scroll restoration mode](#) of the current entry in the [session history](#) as the [scroll restoration mode](#).
  5. Update the [current entry](#) to be this newly added entry.
3. Otherwise:
  1. Let *entry* be *browsingContext*'s [session history](#)'s [current entry](#).
  2. Set *entry*'s [URL](#) to *newURL*.
  3. If *serializedData* is not null, then set *entry*'s [serialized state](#) to *serializedData*.
  4. Update *entry* so that it represents a GET request, if it currently represents a non-GET request (e.g. it was the result of a POST submission).

What does this mean? This is not a part of the definition of [session history entry](#).

4. Set *document's URL* to *newURL*.

Since this is neither a [navigation](#) of the [browsing context](#) nor a [history traversal](#), it does not cause a [hashchange](#) event to be fired.

5. If *serializedData* is not null, then:

1. Let *state* be [StructuredDeserialize](#)(*serializedData*, *document's relevant Realm*). If this throws an exception, catch it, ignore the exception, and set *state* to null.
  2. Set *document's History* instance's [state](#) to *state*.
6. Set the [current entry](#)'s [document's latest entry](#) to the [current entry](#).

The *pushState(data, unused, url)* method steps are to run the [shared history push/replace state steps](#) given *this*, *data*, *url*, and true.

The *replaceState(data, unused, url)* method steps are to run the [shared history push/replace state steps](#) given *this*, *data*, *url*, and false.

The *shared history push/replace state steps*, given a [History history](#), a value *data*, a [scalar value string](#)-or-null *url*, and a boolean *isPush*, are:

1. Let *document* be *history's associated Document*.
2. If *document* is not [fully active](#), then throw a ["SecurityError" DOMException](#).
3. Optionally, return. (For example, the user agent might disallow calls to these methods that are invoked on a timer, or from event listeners that are not triggered in response to a clear user action, or that are invoked in rapid succession.)
4. Let *serializedData* be [StructuredSerializeForStorage](#)(*data*). Rethrow any exceptions.
5. Let *newURL* be the [session history](#)'s [current entry](#)'s [URL](#).
6. If *url* is not null, then:
  1. [Parse](#) *url*, relative to the [relevant settings object](#) of *history*.
  2. If that fails, then throw a ["SecurityError" DOMException](#).
  3. Set *newURL* to the [resulting URL record](#).
4. If *document* [cannot have its URL rewritten](#) to *newURL*, then throw a ["SecurityError" DOMException](#).

- Run the [URL and history update steps](#) given *document* and *newURL*, with *serializedData* set to *serializedData* and *isPush* set to *isPush*.

User agents may limit the number of state objects added to the session history per page. If a page hits the [implementation-defined](#) limit, user agents must remove the entry immediately after the first entry for that [Document](#) object in the session history after having added the new entry. (Thus the state history acts as a FIFO buffer for eviction, but as a LIFO buffer for navigation.)

A [Document](#) document can have its URL rewritten to a [URL](#) *targetURL* if the following algorithm returns true:

- Let *documentURL* be *document*'s [URL](#).
- If *targetURL* and *documentURL* differ in their [scheme](#), [username](#), [password](#), [host](#), or [port](#) components, then return false.
- If *targetURL*'s [scheme](#) is an [HTTP\(S\) scheme](#), then return true. (Differences in [path](#), [query](#), and [fragment](#) are allowed for [http:](#) and [https:](#) URLs.)
- If *targetURL*'s [scheme](#) is "file", and *targetURL* and *documentURL* differ in their [path](#) component, then return false. (Differences in [query](#) and [fragment](#) are allowed for [file:](#) URLs.)
- If *targetURL* and *documentURL* differ in their [path](#) component or [query](#) components, then return false. (Only differences in [fragment](#) are allowed for other types of URLs.)
- Return true.

<i>document</i> 's <a href="#">URL</a>	<i>targetURL</i>
<a href="https://example.com/home">https://example.com/home</a>	<a href="https://example.com/home#about">https://example.com/home#about</a>
<a href="https://example.com/home">https://example.com/home</a>	<a href="https://example.com/home?page=shop">https://example.com/home?page=shop</a>
<a href="https://example.com/home">https://example.com/home</a>	<a href="https://example.com/shop">https://example.com/shop</a>
<a href="https://example.com/home">https://example.com/home</a>	<a href="https://user:pass@example.com/home">https://user:pass@example.com/home</a>
<a href="https://example.com/home">https://example.com/home</a>	<a href="http://example.com/home">http://example.com/home</a>
<a href="file:///path/to/x">file:///path/to/x</a>	<a href="file:///path/to/x#hash">file:///path/to/x#hash</a>
<a href="file:///path/to/x">file:///path/to/x</a>	<a href="file:///path/to/x?search">file:///path/to/x?search</a>
<a href="file:///path/to/x">file:///path/to/x</a>	<a href="file:///path/to/y">file:///path/to/y</a>
<a href="about:blank">about:blank</a>	<a href="about:blank#hash">about:blank#hash</a>
<a href="about:blank">about:blank</a>	<a href="about:blank?search">about:blank?search</a>
<a href="about:blank">about:blank</a>	<a href="about:srcdoc">about:srcdoc</a>
<a href="data:text/html,foo">data:text/html,foo</a>	<a href="data:text/html,foo#hash">data:text/html,foo#hash</a>
<a href="data:text/html,foo">data:text/html,foo</a>	<a href="data:text/html,foo?search">data:text/html,foo?search</a>

<i>document's URL</i>	<i>targetURL</i>
data:text/html,foo	data:text/html,bar
data:text/html,foo	data:bar
blob:https://example.com/77becafe-657b-4fdc-8bd3-e83aaa5e8f43	blob:https://example.com/77becafe-657b-4fdc-8bd3-e83aaa5e8f43#hash
blob:https://example.com/77becafe-657b-4fdc-8bd3-e83aaa5e8f43	blob:https://example.com/77becafe-657b-4fdc-8bd3-e83aaa5e8f43?search
blob:https://example.com/77becafe-657b-4fdc-8bd3-e83aaa5e8f43	blob:https://example.com/anything
blob:https://example.com/77becafe-657b-4fdc-8bd3-e83aaa5e8f43	blob:path

Note how only the [URL](#) of the [Document](#) matters, and not its [origin](#). They can mismatch in cases like [about:blank Document](#)s with inherited origins, in sandboxed [iframes](#), or when the [document.domain](#) setter has been used.

Consider a game where the user can navigate along a line, such that the user is always at some coordinate, and such that the user can bookmark the page corresponding to a particular coordinate, to return to it later.

A static page implementing the x=5 position in such a game could look like the following:

```
<!DOCTYPE HTML>
<!-- this is https://example.com/line?x=5 -->
<html lang="en">
<title>Line Game - 5</title>
<p>You are at coordinate 5 on the line.</p>
<p>
 Advance to 6 or
 retreat to 4?
</p>
```

The problem with such a system is that each time the user clicks, the whole page has to be reloaded. Here instead is another way of doing it, using script:

```
<!DOCTYPE HTML>
<!-- this starts off as https://example.com/line?x=5 -->
<html lang="en">
<title>Line Game - 5</title>
<p>You are at coordinate 5 on the line.</p>
<p>
 Advance to 6 or
 retreat to 4?
</p>
```

```

<script>
 var currentPage = 5; // prefilled by server
 function go(d) {
 setupPage(currentPage + d);
 history.pushState(currentPage, "", '?x=' + currentPage);
 }
 onpopstate = function(event) {
 setupPage(event.state);
 }
 function setupPage(page) {
 currentPage = page;
 document.title = 'Line Game - ' + currentPage;
 document.getElementById('coord').textContent = currentPage;
 document.links[0].href = '?x=' + (currentPage+1);
 document.links[0].textContent = 'Advance to ' + (currentPage+1);
 document.links[1].href = '?x=' + (currentPage-1);
 document.links[1].textContent = 'retreat to ' + (currentPage-1);
 }
</script>

```

In systems without script, this still works like the previous example. However, users that *do* have script support can now navigate much faster, since there is no network access for the same experience. Furthermore, contrary to the experience the user would have with just a naïve script-based approach, bookmarking and navigating the session history still work.

In the example above, the *data* argument to the [pushState\(\)](#) method is the same information as would be sent to the server, but in a more convenient form, so that the script doesn't have to parse the URL each time the user navigates.

Most applications want to use the same [scroll restoration mode](#) value for all of their history entries. To achieve this they can set the [scrollRestoration](#) attribute as soon as possible (e.g., in the first [script](#) element in the document's [head](#) element) to ensure that any entry added to the history session gets the desired scroll restoration mode.

```

<head>
 <script>
 if ('scrollRestoration' in history)
 history.scrollRestoration = 'manual';
 </script>
</head>

```

#### 7.10.4 Implementation notes for session history

*This section is non-normative.*

The [History](#) interface is not meant to place restrictions on how implementations represent the

session history to the user.

For example, session history could be implemented in a tree-like manner, with each page having multiple "forward" pages. This specification doesn't define how the linear list of pages in the [history](#) object are derived from the actual session history as seen from the user's perspective.

Similarly, a page containing two [iframes](#) has a [history](#) object distinct from the [iframes'](#) [history](#) objects, despite the fact that typical web browsers present the user with just one "Back" button, with a session history that interleaves the navigation of the two inner frames and the outer page.

**Security:** It is suggested that to avoid letting a page "hijack" the history navigation facilities of a UA by abusing [pushState\(\)](#), the UA provide the user with a way to jump back to the previous page (rather than just going back to the previous state). For example, the back button could have a drop down showing just the pages in the session history, and not showing any of the states. Similarly, an aural browser could have two "back" commands, one that goes back to the previous state, and one that jumps straight back to the previous page.

For both [pushState\(\)](#) and [replaceState\(\)](#), user agents are encouraged to prevent abuse of these APIs via too-frequent calls or over-large state objects. As detailed above, the algorithm explicitly allows user agents to ignore any such calls when appropriate.

#### 7.10.5 The [Location](#) interface



##### [Document/location](#)

Support in all current engines.

---

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

---

##### [Location](#)

Support in all current engines.

---

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 3+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

## Window/location

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Each [Window](#) object is associated with a unique instance of a [Location](#) object, allocated when the [Window](#) object is created.

The [Location](#) exotic object is defined through a mishmash of IDL, invocation of JavaScript internal methods post-creation, and overridden JavaScript internal methods. Coupled with its scary security policy, please take extra care while implementing this excrescence.

To create a [Location](#) object, run these steps:

1. Let *location* be a new [Location platform object](#).
2. Let *valueOf* be *location*'s [relevant Realm](#).[\[\[Intrinsics\]\]](#).[\[\[%Object.prototype.valueOf%\]\]](#).
3. Perform ! *location*.[\[\[DefineOwnProperty\]\]](#)(**valueOf**, { [\[\[Value\]\]](#): *valueOf*, [\[\[Writable\]\]](#): false, [\[\[Enumerable\]\]](#): false, [\[\[Configurable\]\]](#): false }).
4. Perform ! *location*.[\[\[DefineOwnProperty\]\]](#)([\[@@toPrimitive](#), { [\[\[Value\]\]](#): undefined, [\[\[Writable\]\]](#): false, [\[\[Enumerable\]\]](#): false, [\[\[Configurable\]\]](#): false }).
5. Set the value of the [\[\[DefaultProperties\]\]](#) internal slot of *location* to *location*.[\[\[OwnPropertyKeys\]\]](#)().
6. Return *location*.

The addition of **valueOf** and [\[@@toPrimitive](#) own data properties, as well as the fact that all of [Location](#)'s IDL attributes are marked [\[LegacyUnforgeable\]](#), is required by legacy code that consulted the [Location](#) interface, or stringified it, to determine the [document URL](#), and then used it in a security-sensitive way. In particular, the **valueOf**, [\[@@toPrimitive](#), and [\[LegacyUnforgeable\]](#) stringifier mitigations ensure that code such as `foo[location] = bar` or `location + ""` cannot be misdirected.

**`document.location [ = value ]`**  
**`window.location [ = value ]`**

Returns a [Location](#) object with the current page's location.

Can be set, to navigate to another page.

The [Document](#) object's *location* getter steps are to return [this](#)'s [relevant global object](#)'s [Location](#) object, if [this](#) is [fully active](#), and null otherwise.

The [Window](#) object's *location* getter steps are to return [this](#)'s [Location](#) object.

[Location](#) objects provide a representation of the [URL](#) of the [active document](#) of their [Document](#)'s [browsing context](#), and allow the [current entry](#) of the [browsing context](#)'s session history to be changed, by adding or replacing entries in the [history](#) object.

[Exposed=Window]

```
interface Location { // but see also additional creation steps and overridden
 [LegacyUnforgeable] stringifier attribute USVString href;
 [LegacyUnforgeable] readonly attribute USVString origin;
 [LegacyUnforgeable] attribute USVString protocol;
 [LegacyUnforgeable] attribute USVString host;
 [LegacyUnforgeable] attribute USVString hostname;
 [LegacyUnforgeable] attribute USVString port;
 [LegacyUnforgeable] attribute USVString pathname;
 [LegacyUnforgeable] attribute USVString search;
 [LegacyUnforgeable] attribute USVString hash;

 [LegacyUnforgeable] undefined assign(USVString url);
 [LegacyUnforgeable] undefined replace(USVString url);
 [LegacyUnforgeable] undefined reload();

 [LegacyUnforgeable, SameObject] readonly attribute DOMStringList ancestorOrSelf;
};
```

[location.toString\(\)](#)

[location.href](#)

✓MDN

[Location/href](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 3+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

[Location/toString](#)

Support in all current engines.

Firefox22+Safari1+Chrome52+

---

Opera?Edge79+

---

Edge (Legacy)12+Internet Explorer11

---

Firefox Android22+Safari iOS1+Chrome Android52+WebView Android52+Samsung Internet6.0+Opera Android?

Returns the [Location](#) object's URL.

Can be set, to navigate to the given URL.

### ***location.origin***

✓MDN

[Location/origin](#)

Support in all current engines.

Firefox21+Safari5.1+Chrome8+

---

Opera15+Edge79+

---

Edge (Legacy)12+Internet Explorer11

---

Firefox Android21+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android14+

Returns the [Location](#) object's URL's origin.

### ***location.protocol***

✓MDN

[Location/protocol](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer3+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Returns the [Location](#) object's URL's scheme.

Can be set, to navigate to the same URL with a changed scheme.

### ***location.host***

✓MDN

## [Location/host](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 3+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [Location](#) object's URL's host and port (if different from the default port for the scheme).

Can be set, to navigate to the same URL with a changed host and port.

## [location.hostname](#)

✓MDN

### [Location/hostname](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 3+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [Location](#) object's URL's host.

Can be set, to navigate to the same URL with a changed host.

## [location.port](#)

✓MDN

### [Location/port](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 3+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [Location](#) object's URL's port.

Can be set, to navigate to the same URL with a changed port.

## ***location.pathname***

✓MDN

### [Location.pathname](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 3+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [Location](#) object's URL's path.

Can be set, to navigate to the same URL with a changed path.

## ***location.search***

✓MDN

### [Location/search](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 3+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [Location](#) object's URL's query (includes leading "?" if non-empty).

Can be set, to navigate to the same URL with a changed query (ignores leading "?").

## ***location.hash***

✓MDN

### [Location/hash](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet Explorer3+

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Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

Returns the [Location](#) object's URL's fragment (includes leading "#" if non-empty).

Can be set, to navigate to the same URL with a changed fragment (ignores leading "#").

### **`location.assign(url)`**

✓MDN

[Location/assign](#)

Support in all current engines.

Firefox1+Safari3+Chrome1+

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Opera3+Edge79+

---

Edge (Legacy)12+Internet Explorer5.5+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android10.1+

Navigates to the given URL.

### **`location.replace(url)`**

✓MDN

[Location/replace](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera3+Edge79+

---

Edge (Legacy)12+Internet Explorer5.5+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android10.1+

Removes the current page from the session history and navigates to the given URL.

### **`location.reload()`**

✓MDN

[Location/reload](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera3+Edge79+

---

Edge (Legacy)12+Internet Explorer5.5+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Reloads the current page.

## [\*\*location.ancestorOrigins\*\*](#)

MDN

### [Location/ancestorOrigins](#)

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FirefoxNoSafari6+Chrome20+

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Opera15+Edge79+

---

Edge (Legacy)NoInternet ExplorerNo

---

Firefox AndroidNoSafari iOS6+Chrome Android25+WebView Android4.4+Samsung Internet1.5+Opera Android14+

Returns a [DOMStringList](#) object listing the origins of the ancestor [browsing contexts](#), from the [parent browsing context](#) to the [top-level browsing context](#).

A [Location](#) object has an associated *relevant Document*, which is this [Location](#) object's [relevant global object](#)'s [browsing context's active document](#), if this [Location](#) object's [relevant global object](#)'s [browsing context](#) is non-null, and null otherwise.

A [Location](#) object has an associated *url*, which is this [Location](#) object's [relevant Document's URL](#), if this [Location](#) object's [relevant Document](#) is non-null, and [about:blank](#) otherwise.

A [Location](#) object has an associated *ancestor origins list*. When a [Location](#) object is created, its [ancestor origins list](#) must be set to a [DOMStringList](#) object whose associated list is the [list](#) of strings that the following steps would produce:

1. Let *output* be a new [list](#) of strings.
2. Let *current* be the [browsing context](#) of the [Document](#) with which this [Location](#) object is associated.
3. *Loop*: If *current* has no [parent browsing context](#), jump to the step labeled *end*.
4. Let *current* be *current*'s [parent browsing context](#).
5. [Append](#) the [serialization](#) of *current*'s [active document](#)'s [origin](#) to *output*.
6. Return to the step labeled *loop*.

7. End: Return *output*.

To *Location-object navigate*, given a [URL url](#) and an optional [history handling behavior historyHandling](#) (default "[default](#)"):

1. Let *browsingContext* be this [Location](#) object's [relevant global object](#)'s [browsing context](#).
2. Let *sourceBrowsingContext* be the [incumbent global object](#)'s [browsing context](#).
3. If *browsingContext* is still on its initial [about:blank Document](#), then set *historyHandling* to "[replace](#)".
4. If this [Location](#) object's [relevant Document](#) is not yet [completely loaded](#), and the [incumbent global object](#) does not have [transient activation](#), then set *historyHandling* to "[replace](#)".
5. [Navigate](#) *browsingContext* to *url*, with [exceptionsEnabled](#) set to true, [historyHandling](#) set to *historyHandling*, and the [source browsing context](#) set to *sourceBrowsingContext*.

The *href* getter steps are:

1. If *this*'s [relevant Document](#) is non-null and its [origin](#) is not [same origin-domain](#) with the [entry settings object](#)'s [origin](#), then throw a "[SecurityError](#)" [DOMException](#).
2. Return *this*'s [url](#), [serialized](#).

The *href* setter steps are:

1. If *this*'s [relevant Document](#) is null, then return.
2. [Parse](#) the given value relative to the [entry settings object](#). If that failed, throw a [TypeError](#) exception.
3. [Location-object navigate](#) given the [resulting URL record](#).

The *href* setter intentionally has no security check.

The *origin* getter steps are:

1. If *this*'s [relevant Document](#) is non-null and its [origin](#) is not [same origin-domain](#) with the [entry settings object](#)'s [origin](#), then throw a "[SecurityError](#)" [DOMException](#).
2. Return the [serialization](#) of *this*'s [url](#)'s [origin](#).

The *protocol* getter steps are:

1. If this's relevant Document is non-null and its origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
2. Return this's url's scheme, followed by ":".

The protocol setter steps are:

1. If this's relevant Document is null, then return.
2. If this's relevant Document's origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
3. Let copyURL be a copy of this's url.
4. Let possibleFailure be the result of basic URL parsing the given value, followed by ":" , with copyURL as url and scheme start state as state override.

Because the URL parser ignores multiple consecutive colons, providing a value of "https:" (or even "https:::") is the same as providing a value of "https".

5. If possibleFailure is failure, then throw a "SyntaxError" DOMException.
6. If copyURL's scheme is not an HTTP(S) scheme, then terminate these steps.
7. Location-object navigate to copyURL.

The host getter steps are:

1. If this's relevant Document is non-null and its origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
2. Let url be this's url.
3. If url's host is null, return the empty string.
4. If url's port is null, return url's host, serialized.
5. Return url's host, serialized, followed by ":" and url's port, serialized.

The host setter steps are:

1. If this's relevant Document is null, then return.
2. If this's relevant Document's origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
3. Let copyURL be a copy of this's url.

4. If *copyURL* has an [opaque path](#), then return.
5. [Basic URL parse](#) the given value, with *copyURL* as *url* and [host state](#) as [state override](#).
6. [Location-object navigate](#) to *copyURL*.

The [hostname](#) getter steps are:

1. If *this*'s [relevant Document](#) is non-null and its [origin](#) is not [same origin-domain](#) with the [entry settings object's origin](#), then throw a ["SecurityError" DOMException](#).
2. If *this*'s [url](#)'s [host](#) is null, return the empty string.
3. Return *this*'s [url](#)'s [host, serialized](#).

The [hostname](#) setter steps are:

1. If *this*'s [relevant Document](#) is null, then return.
2. If *this*'s [relevant Document](#)'s [origin](#) is not [same origin-domain](#) with the [entry settings object's origin](#), then throw a ["SecurityError" DOMException](#).
3. Let *copyURL* be a copy of *this*'s [url](#).
4. If *copyURL* has an [opaque path](#), then return.
5. [Basic URL parse](#) the given value, with *copyURL* as *url* and [hostname state](#) as [state override](#).
6. [Location-object navigate](#) to *copyURL*.

The [port](#) getter steps are:

1. If *this*'s [relevant Document](#) is non-null and its [origin](#) is not [same origin-domain](#) with the [entry settings object's origin](#), then throw a ["SecurityError" DOMException](#).
2. If *this*'s [url](#)'s [port](#) is null, return the empty string.
3. Return *this*'s [url](#)'s [port, serialized](#).

The [port](#) setter steps are:

1. If *this*'s [relevant Document](#) is null, then return.
2. If *this*'s [relevant Document](#)'s [origin](#) is not [same origin-domain](#) with the [entry settings object's origin](#), then throw a ["SecurityError" DOMException](#).
3. Let *copyURL* be a copy of *this*'s [url](#).

4. If *copyURL* cannot have a username/password/port, then return.
5. If the given value is the empty string, then set *copyURL*'s port to null.
6. Otherwise, basic URL parse the given value, with *copyURL* as url and port state as state override.
7. Location-object navigate to *copyURL*.

The pathname getter steps are:

1. If this's relevant Document is non-null and its origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
2. Return the result of URL path serializing this Location object's url.

The pathname setter steps are:

1. If this's relevant Document is null, then return.
2. If this's relevant Document's origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
3. Let *copyURL* be a copy of this's url.
4. If *copyURL* has an opaque path, then return.
5. Set *copyURL*'s path to the empty list.
6. Basic URL parse the given value, with *copyURL* as url and path start state as state override.
7. Location-object navigate to *copyURL*.

The search getter steps are:

1. If this's relevant Document is non-null and its origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
2. If this's url's query is either null or the empty string, return the empty string.
3. Return "?", followed by this's url's query.

The search setter steps are:

1. If this's relevant Document is null, then return.
2. If this's relevant Document's origin is not same origin-domain with the entry settings

object's origin, then throw a "SecurityError" DOMException.

3. Let copyURL be a copy of this's url.
4. If the given value is the empty string, set copyURL's query to null.
5. Otherwise, run these substeps:
  1. Let input be the given value with a single leading "?" removed, if any.
  2. Set copyURL's query to the empty string.
  3. Basic URL parse input, with null, the relevant Document's document's character encoding, copyURL as url, and query state as state override.
6. Location-object navigate to copyURL.

The hash getter steps are:

1. If this's relevant Document is non-null and its origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
2. If this's url's fragment is either null or the empty string, return the empty string.
3. Return "#", followed by this's url's fragment.

The hash setter steps are:

1. If this's relevant Document is null, then return.
2. If this's relevant Document's origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
3. Let copyURL be a copy of this's url.
4. Let input be the given value with a single leading "#" removed, if any.
5. Set copyURL's fragment to the empty string.
6. Basic URL parse input, with copyURL as url and fragment state as state override.
7. Location-object navigate to copyURL.

Unlike the equivalent API for the a and area elements, the hash setter does not special case the empty string, to remain compatible with deployed scripts.

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The assign(url) method steps are:

1. If this's relevant Document is null, then return.
2. If this's relevant Document's origin is not same origin-domain with the entry settings object's origin, then throw a "SecurityError" DOMException.
3. Parse url relative to the entry settings object. If that failed, throw a "SyntaxError" DOMException.
4. Location-object navigate given the resulting URL record.

The replace(url) method steps are:

1. If this's relevant Document is null, then return.
2. Parse url relative to the entry settings object. If that failed, throw a "SyntaxError" DOMException.
3. Location-object navigate given the resulting URL record and "replace".

The replace() method intentionally has no security check.

The reload() method steps are to run the appropriate steps from the following list:

If this's relevant Document is null

Return.

If this's relevant Document's origin is not same origin-domain with the entry settings object's origin

Throw a "SecurityError" DOMException.

If the currently executing task is the dispatch of a resize event in response to the user resizing the browsing context

Repaint the browsing context and return.

If the browsing context's active document is an iframe srcdoc document

Reprocess the iframe attributes of the browsing context's container.

Otherwise

Navigate the browsing context to this's relevant Document's URL, with exceptionsEnabled set to true, historyHandling set to "reload", and the source browsing context set to the browsing context being navigated.

When a user requests that the [active document](#) of a [browsing context](#) be reloaded through a user interface element, the user agent should [navigate the browsing context](#) to the same resource as that [Document](#), with [historyHandling](#) set to "[reload](#)". In the case of non-idempotent methods (e.g., HTTP POST), the user agent should prompt the user to confirm the operation first, since otherwise transactions (e.g., purchases or database modifications) could be repeated. User agents may allow the user to explicitly override any caches when reloading.

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The [ancestorOrigins](#) getter steps are:

1. If [this's relevant Document](#) is null, then return an empty [list](#).
2. If [this's relevant Document's origin](#) is not [same origin-domain](#) with the [entry settings object's origin](#), then throw a "[SecurityError](#)" [DOMException](#).
3. Otherwise, return [this's ancestor origins list](#).

The details of how the [ancestorOrigins](#) attribute works are still controversial and might change. See [issue #1918](#) for more information.

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As explained earlier, the [Location](#) exotic object requires additional logic beyond IDL for security purposes. The [Location](#) object must use the ordinary internal methods except where it is explicitly specified otherwise below.

Also, every [Location](#) object has a [\[\[DefaultProperties\]\]](#) internal slot representing its own properties at time of its creation.

#### 7.10.5.1 [[GetPrototypeOf]]()

1. If ! [IsPlatformObjectSameOrigin\(this\)](#) is true, then return ! [OrdinaryGetPrototypeOf\(this\)](#).
2. Return null.

#### 7.10.5.2 [[SetPrototypeOf]]( V )

1. Return ! [SetImmutablePrototype\(this, V\)](#).

#### 7.10.5.3 [[IsExtensible]]()

1. Return true.

#### 7.10.5.4 [[PreventExtensions]]()

1. Return false.

#### 7.10.5.5 [[GetOwnProperty]] ( $P$ )

1. If ! [IsPlatformObjectSameOrigin](#)(*this*) is true, then:
  1. Let *desc* be ! [OrdinaryGetOwnProperty](#)(*this*,  $P$ ).
  2. If the value of the [\[\[DefaultProperties\]\]](#) internal slot of *this* contains  $P$ , then set *desc*.[[Configurable]] to true.
  3. Return *desc*.
2. Let *property* be ! [CrossOriginGetOwnPropertyHelper](#)(*this*,  $P$ ).
3. If *property* is not undefined, then return *property*.
4. Return ? [CrossOriginPropertyFallback](#)( $P$ ).

#### 7.10.5.6 [[DefineOwnProperty]] ( $P$ , *Desc* )

1. If ! [IsPlatformObjectSameOrigin](#)(*this*) is true, then:
  1. If the value of the [\[\[DefaultProperties\]\]](#) internal slot of *this* contains  $P$ , then return false.
  2. Return ? [OrdinaryDefineOwnProperty](#)(*this*,  $P$ , *Desc*).
2. Throw a ["SecurityError" DOMException](#).

#### 7.10.5.7 [[Get]] ( $P$ , *Receiver* )

1. If ! [IsPlatformObjectSameOrigin](#)(*this*) is true, then return ? [OrdinaryGet](#)(*this*,  $P$ , *Receiver*).
2. Return ? [CrossOriginGet](#)(*this*,  $P$ , *Receiver*).

#### 7.10.5.8 [[Set]] ( $P$ , $V$ , *Receiver* )

1. If ! [IsPlatformObjectSameOrigin](#)(*this*) is true, then return ? [OrdinarySet](#)(*this*,  $P$ ,  $V$ , *Receiver*).
2. Return ? [CrossOriginSet](#)(*this*,  $P$ ,  $V$ , *Receiver*).

#### 7.10.5.9 [[Delete]] ( $P$ )

1. If ! [IsPlatformObjectSameOrigin](#)(*this*) is true, then return ? [OrdinaryDelete](#)(*this*,  $P$ ).
2. Throw a ["SecurityError" DOMException](#).

## 7.10.5.10 [[OwnPropertyKeys]]()

1. If ! [IsPlatformObjectSameOrigin](#)(this) is true, then return ! [OrdinaryOwnPropertyKeys](#)(this).
2. Return ! [CrossOriginOwnPropertyKeys](#)(this).

## 7.11 Browsing the web

### 7.11.1 Navigating across documents

Certain actions cause the [browsing context](#) to [navigate](#) to a new resource. A user agent may provide various ways for the user to explicitly cause a browsing context to navigate, in addition to those defined in this specification.

For example, [following a hyperlink](#), [form submission](#), and the [window.open\(\)](#) and [location.assign\(\)](#) methods can all cause a browsing context to navigate.

A resource has a URL, but that might not be the only information necessary to identify it. For example, a form submission that uses HTTP POST would also have the HTTP method and payload. Similarly, [an iframe srcdoc document](#) needs to know the data it is to use.

Much of the navigation process is concerned with determining how to create a new [Document](#), which ultimately happens in the [create and initialize a Document object](#) algorithm. The parameters to this algorithm are tracked via a *navigation params struct*, which has the following [items](#):

*id*

A [navigation id](#).

*request*

null or a [request](#) that started the navigation

*response*

a [response](#) that ultimately was navigated to (potentially a [network error](#))

*origin*

an [origin](#) to use for the new [Document](#)

*policy container*

a [policy container](#) to use for the new [Document](#)

*final sandboxing flag set*

a [sandboxing flag set](#) to impose on the new [Document](#)

*cross-origin opener policy*

a [cross-origin opener policy](#) to use for the new [Document](#)

### *COOP enforcement result*

a [cross-origin opener policy enforcement result](#), used for reporting and potentially for causing a [browsing context group switch](#)

### *reserved environment*

null or an [environment](#) reserved for the new [Document](#)

### *browsing context*

the [browsing context](#) to be navigated (or discarded, if a [browsing context group switch](#) occurs)

### *history handling*

a [history handling behavior](#)

### *has cross-origin redirects*

a boolean

Once a [navigation params](#) struct is created, this standard does not mutate any of its [items](#). They are only passed onward to other algorithms.

After [Document](#) creation, the [session history](#) gets updated. A *history handling behavior* is used to track the desired type of session history update throughout the navigation process. It is one of the following:

#### **"default"**

A regular navigation which adds a new entry to the session history.

#### **"entry update"**

A navigation to an existing [session history entry](#) to recreate that entry's [document](#), which was previously [discarded](#).

#### **"reload"**

A navigation intended to reload the current page and replace the [current session history entry](#).

#### **"replace"**

A non-reload navigation that will replace the [current session history entry](#).

Navigation always involves *source browsing context*, which is the browsing context which was responsible for starting the navigation.

As explained in [issue #1130](#) the use of a browsing context as source might not be the correct architecture.

A navigation has a *navigation id*, which is a unique string.

To *navigate* a browsing context *browsingContext* to a resource *resource*, with an optional boolean *exceptionsEnabled* (default false), an optional [history handling behavior](#)

*historyHandling* (default "[default](#)"), an optional [policy container](#)-or-null *historyPolicyContainer* (default null), an optional string *navigationType* (default "[other](#)"), and an optional [navigation id](#) *navigationId* (default null):

1. If *resource* is a [URL](#), then set *resource* to a new [request](#) whose [URL](#) is *resource*.
2. If *resource* is a [request](#) and *historyHandling* is "[reload](#)", then set *resource*'s [reload-navigation flag](#).
3. If the [source browsing context](#) is not [allowed to navigate](#) *browsingContext*, then:
  1. If *exceptionsEnabled* is given and is true, then throw a "[SecurityError](#)" [DOMException](#).
  2. Otherwise, the user agent may instead offer to open *resource* in a new [top-level browsing context](#) or in the [top-level browsing context](#) of the [source browsing context](#), at the user's option, in which case the user agent must [navigate](#) that designated [top-level browsing context](#) to *resource* as if the user had requested it independently.

Doing so, however, can be dangerous, as it means that the user is overriding the author's explicit request to sandbox the content.

4. If *navigationId* is null:
  1. *historyHandling* is "[reload](#)", and *browsingContext*'s [active document](#)'s [navigation id](#) is not null, let *navigationId* be *browsingContext*'s [active document](#)'s [navigation id](#). Otherwise let *navigation id* be the result of [generating a random UUID](#). [\[UUID\]](#)
  5. If *browsingContext*'s [active document](#)'s [unload counter](#) is greater than 0, then invoke [WebDriver BiDi navigation failed](#) with a [WebDriver BiDi navigation status](#) whose [id](#) is *navigationId*, [status](#) is "[canceled](#)", and [url](#) is *resource*'s [url](#), and return.
  6. If *historyHandling* is not "[reload](#)", *resource* is a [request](#), *resource*'s [URL equals](#) *browsingContext*'s [active document](#)'s [URL](#) with [exclude fragments](#) set to true, and *resource*'s [URL](#)'s [fragment](#) is non-null, then:
    1. [Navigate to a fragment](#) given *browsingContext*, *resource*'s [URL](#), *historyHandling*, and *navigationId*.
    2. Return.
  7. If *historyHandling* is "[default](#)", *resource* is a [request](#), and either *resource*'s [URL equals](#) *browsingContext*'s [active document](#)'s [URL](#) or *resource*'s [URL](#)'s [scheme](#) is "[javascript](#)", then set *historyHandling* to "[replace](#)".

8. Let *incumbentNavigationOrigin* be the [origin](#) of the [incumbent settings object](#), or if no [script](#) was involved, the [origin](#) of the [node document](#) of the element that initiated the [navigation](#).
9. Let *initiatorPolicyContainer* be a [clone](#) of the [source browsing context's active document's policy container](#).
10. If *resource* is a [request](#), then set *resource*'s [policy container](#) to *initiatorPolicyContainer*.
11. Cancel any preexisting but not yet [mature](#) attempt to navigate *browsingContext*, including canceling any instances of the [fetch](#) algorithm started by those attempts. If one of those attempts has already [created and initialized a new Document object](#), [abort](#) that [Document](#) also. (Navigation attempts that have [matured](#) already have session history entries, and are therefore handled during the [update the session history with the new page](#) algorithm, later.)
12. [Prompt to unload](#) the [active document](#) of *browsingContext*. If the user [refused to allow the document to be unloaded](#), then return a new [WebDriver BiDi navigation status](#) whose [id](#) is *navigationId* and [status](#) is "[canceled](#)".

If this instance of the [navigation](#) algorithm gets canceled while this step is running, the [prompt to unload](#) algorithm must nonetheless be run to completion.

13. [Abort](#) the [active document](#) of *browsingContext*.
14. If *browsingContext* is a [child browsing context](#), then put it in the [delaying load events mode](#).

The user agent must take this [child browsing context](#) out of the [delaying load events mode](#) when this [navigation](#) algorithm later [matures](#), or when it terminates (whether due to having run all the steps, or being canceled, or being aborted), whichever happens first.

15. Let *sandboxFlags* be the result of [determining the creation sandboxing flags](#) given *browsingContext* and *browsingContext*'s [container](#).
16. Let *allowedToDownload* be the result of running the [allowed to download](#) algorithm given the [source browsing context](#) and *browsingContext*.
17. Let *hasTransientActivation* be true if the [source browsing context's active window](#) has [transient activation](#); otherwise false.
18. Let *navigationStatus* be
19. Invoke [WebDriver BiDi navigation started](#) with *browsingContext*, and a new [WebDriver BiDi navigation status](#) whose [id](#) is *navigationId*, [url](#) is *resource*'s [url](#), and [status](#) is "[pending](#)".

20. Return, and continue running these steps [in parallel](#).
21. This is the step that attempts to obtain *resource*, if necessary. Jump to the first appropriate substep:

If *resource* is a [response](#)

1. Assert: *browsingContext* is not a [top-level browsing context](#).
2. Let *finalSandboxFlags* be the [union](#) of *browsingContext*'s [sandboxing flags](#) and *resource*'s [forced sandboxing flag set](#).
3. Let *responseOrigin* be the result of [determining the origin](#) given *browsingContext*, *resource*'s [url](#), *finalSandboxFlags*, and *incumbentNavigationOrigin*.
4. Let *coop* be a new [cross-origin opener policy](#).
5. Let *coopEnforcementResult* be a new [cross-origin opener policy enforcement result](#) whose [needs a browsing context group switch](#) is false, [would need a browsing context group switch due to report-only](#) is false, [url](#) is *resource*'s [url](#), [origin](#) is *responseOrigin*, [cross-origin opener policy](#) is *coop*, and [current context is navigation source](#) is false.
6. Let *policyContainer* be the result of [determining navigation params policy container](#) given *resource*'s [url](#), *historyPolicyContainer*, *initiatorPolicyContainer*, *browsingContext*'s [parent browsing context](#)'s [active document](#)'s [policy container](#), and null.
7. Let *navigationParams* be a new [navigation params](#) whose [id](#) is *navigationId*, [request](#) is null, [response](#) is *resource*, [origin](#) is *responseOrigin*, [policy container](#) is *policyContainer*, [final sandboxing flag set](#) is *finalSandboxFlags*, [cross-origin opener policy](#) is *coop*, [COOP enforcement result](#) is *coopEnforcementResult*, [reserved environment](#) is null, [browsing context](#) is *browsingContext*, [history handling](#) is *historyHandling*, and [has cross-origin redirects](#) is false.
8. Run [process a navigate response](#) with *navigationType*, *allowedToDownload*, *hasTransientActivation*, and *navigationParams*.

If *resource* is a [request](#) whose [URL's scheme](#) is "**javascript**"

[Queue a global task](#) on the [DOM manipulation task source](#) given *browsingContext*'s [active window](#) to run these steps:

1. Let *response* be the result of [executing a javascript: URL request](#) given *resource*, *browsingContext*, and *incumbentNavigationOrigin*.

2. Let *finalSandboxFlags* be the union of *browsingContext's sandboxing flags* and *response's forced sandboxing flag set*.
3. Let *coopEnforcementResult* be a new cross-origin opener policy enforcement result whose needs a browsing context group switch is false, would need a browsing context group switch due to report-only is false, url is resource's URL, origin is browsingContext's active document's origin, cross-origin opener policy is browsingContext's active document's cross-origin opener policy, and current context is navigation source is false.
4. Let *navigationParams* be a new navigation params whose id is *navigationId*, request is resource, response is response, origin is browsingContext's active document's origin, policy container is browsingContext's active document's policy container, final sandboxing flag set is finalSandboxFlags, cross-origin opener policy is browsingContext's active document's cross-origin opener policy, COOP enforcement result is coopEnforcementResult, reserved environment is null, browsing context is browsingContext, history handling is historyHandling, and has cross-origin redirects is false.
5. Run process a navigate response with *navigationType*, *allowedToDownload*, *hasTransientActivation*, and *navigationParams*.

So for example a javascript: URL in an href attribute of an a element would only be evaluated when the link was followed, while such a URL in the src attribute of an iframe element would be evaluated in the context of the iframe's nested browsing context when the iframe is being set up. Once evaluated, its return value (if it was a string) would replace that browsing context's active document, thus also changing the corresponding Window object.

If *resource* is a request whose URL's scheme is a fetch scheme

Run process a navigate fetch given *navigationId*, *resource*, the source browsing context, *browsingContext*, *navigationType*, *sandboxFlags*, *historyPolicyContainer*, *initiatorPolicyContainer*, *allowedToDownload*, *hasTransientActivation*, *incumbentNavigationOrigin*, and *historyHandling*.

Otherwise, *resource* is a request whose URL's scheme is neither "javascript" nor a fetch scheme

Run process a navigate URL scheme given *resource's URL*, *browsingContext*, *sandboxFlags*, and *hasTransientActivation*.

To process a navigate fetch, given a navigation id *navigationId*, request *request*, two browsing contexts *sourceBrowsingContext* and *browsingContext*, a string *navigationType*, a sandboxing flag set *sandboxFlags*, two policy containers *historyPolicyContainer* and *initiatorPolicyContainer*, a boolean *allowedToDownload*, a boolean *hasTransientActivation*, an

origin *incumbentNavigationOrigin*, and a history handling behavior *historyHandling*:

1. Let *response* be null.
2. Set *request*'s client to *sourceBrowsingContext*'s active document's relevant settings object, destination to "document", mode to "navigate", credentials mode to "include", use-URL-credentials flag, redirect mode to "manual", and replaces client id to *browsingContext*'s active document's relevant settings object's id.
3. If *hasTransientActivation* is true, then set *request*'s user-activation to true.
4. If *browsingContext*'s container is non-null:
  1. If the *browsingContext*'s container has a browsing context scope origin, then set *request*'s origin to that browsing context scope origin.
  2. Set *request*'s destination to *browsingContext*'s container's local name.
5. Let *responseOrigin* be null.
6. Let *currentContextIsSource* be the result of whether *browsingContext*'s active document is same origin with *sourceBrowsingContext*'s active document.
7. Let *coopEnforcementResult* be a new cross-origin opener policy enforcement result whose needs a browsing context group switch is false, would need a browsing context group switch due to report-only is false, url is *browsingContext*'s active document's url, origin is *browsingContext*'s active document's origin, cross-origin opener policy is *browsingContext*'s active document's cross-origin opener policy, and current context is navigation source is *currentContextIsSource*.
8. Let *finalSandboxFlags* be an empty sandboxing flag set.
9. Let *responseCOOP* be a new cross-origin opener policy.
10. Let *locationURL* be null.
11. Let *currentURL* be *request*'s current URL.
12. Let *hasCrossOriginRedirects* be false.
13. While true:
  1. If *locationURL* is non-null, then:
    1. If *locationURL*'s origin is not the same as *currentURL*'s origin, then set *hasCrossOriginRedirects* to true.
    2. Set *currentURL* to *locationURL*.

2. If *request*'s [reserved client](#) is not null and *currentURL*'s [origin](#) is not the [same](#) as *request*'s [reserved client's creation URL](#)'s [origin](#), then:
  1. Run the [environment discarding steps](#) for *request*'s [reserved client](#).
  2. Set *request*'s [reserved client](#) to null.
3. If *request*'s [reserved client](#) is null, then:
  1. Let *topLevelCreationURL* be *currentURL*.
  2. Let *topLevelOrigin* be null.
  3. If *browsingContext* is not a [top-level browsing context](#), then:
    1. Let *parentEnvironment* be *browsingContext*'s [container's relevant settings object](#).
    2. Set *topLevelCreationURL* to *parentEnvironment*'s [top-level creation URL](#) and *topLevelOrigin* to *parentEnvironment*'s [top-level origin](#).
  4. Set *request*'s [reserved client](#) to a new [environment](#) whose [id](#) is a unique opaque string, [target browsing context](#) is *browsingContext*, [creation URL](#) is *currentURL*, [top-level creation URL](#) is *topLevelCreationURL*, and [top-level origin](#) is *topLevelOrigin*.

The created environment's [active service worker](#) is set in the [Handle Fetch](#) algorithm during the fetch if the request URL matches a service worker registration. [\[SW\]](#)

4. If the result of [Should navigation request of type be blocked by Content Security Policy?](#) given *request* and *navigationType* is "Blocked", then set *response* to a [network error](#) and [break](#). [\[CSP\]](#)
5. Otherwise:
  1. If *response* is null, [fetch](#) *request*.
  2. Otherwise, perform [HTTP-redirect fetch](#) using *request* and *response*.
  3. Wait for the [task](#) on the [networking task source](#) to [process response](#) and set *response* to the result.
  4. Set *finalSandboxFlags* to the [union](#) of *browsingContext*'s [sandboxing flags](#) and *response*'s [forced sandboxing flag set](#).
  5. Set *responseOrigin* to the result of [determining the origin](#) given

*browsingContext*, *request*'s [URL](#), *finalSandboxFlags*, and *incumbentNavigationOrigin*.

6. If *browsingContext* is a [top-level browsing context](#), then:
  1. Set *responseCOOP* to the result of [obtaining a cross-origin opener policy](#) given *response* and *request*'s [reserved client](#).
  2. If *sandboxFlags* is not empty and *responseCOOP*'s [value](#) is not "[unsafe-none](#)", then set *response* to an appropriate [network error](#) and [break](#).

This results in a network error as one cannot simultaneously provide a clean slate to a response using cross-origin opener policy and sandbox the result of navigating to that response.
  3. Set *coopEnforcementResult* to the result of [enforcing the response's cross-origin opener policy](#) given *browsingContext*, *request*'s [URL](#), *responseOrigin*, *responseCOOP*, *coopEnforcementResult* and *request*'s [referrer](#).
7. If *response* is not a [network error](#), *browsingContext* is a [child browsing context](#), and the result of performing a [cross-origin resource policy check](#) with *browsingContext*'s [container document](#)'s [origin](#), *browsingContext*'s [container document](#)'s [relevant settings object](#), *request*'s [destination](#), *response*, and *true* is [blocked](#), then set *response* to a [network error](#) and [break](#).

Here we're running the [cross-origin resource policy check](#) against the [parent browsing context](#) rather than *sourceBrowsingContext*. This is because we care about the same-originness of the embedded content against the parent context, not the navigation source.

8. Set *locationURL* to *response*'s [location URL](#) given *currentURL*'s [fragment](#).
9. If *locationURL* is not a [URL](#) whose [scheme](#) is an [HTTP\(S\) scheme](#), then [break](#).

Navigation handles redirects manually as navigation is the only place in the web platform that cares for redirects to [mailto:](#) URLs and such.

By the end of this loop we will be in one of these scenarios:

- *response* is a [network error](#).
- *locationURL* is failure, because of an unparseable 'Location' header.

- *locationURL* is null, because we successfully fetched a non-[network error](#) HTTP(S) response with no 'Location' header.
  - *locationURL* is a [URL](#) with a non-[HTTP\(S\) scheme](#).
14. If *locationURL* is failure, then set *response* to a [network error](#).
15. Otherwise, if *locationURL* is a [URL](#) whose [scheme](#) is a [fetch scheme](#) or "javascript", then set *response* to a [network error](#).
16. Otherwise, if *locationURL* is a [URL](#), then [process a navigate URL scheme](#) given *locationURL*, *browsingContext*, *sandboxFlags*, and *hasTransientActivation*, and return.
17. Let *responsePolicyContainer* be the result of [creating a policy container from a fetch response](#) given *response* and *request*'s [reserved client](#).
18. Let *resultPolicyContainer* be the result of [determining navigation params policy container](#) given *response*'s [URL](#), *historyPolicyContainer*, *initiatorPolicyContainer*, null, and *responsePolicyContainer*.
19. Let *navigationParams* be a new [navigation params](#) whose [id](#) is *navigationId*, [request](#) is *request*, [response](#) is *response*, [origin](#) is *responseOrigin*, [policy container](#) is *resultPolicyContainer*, [final sandboxing flag set](#) is *finalSandboxFlags*, [cross-origin opener policy](#) is *responseCOOP*, [COOP enforcement result](#) is *coopEnforcementResult*, [reserved environment](#) is *request*'s [reserved client](#), [browsing context](#) is *browsingContext*, [history handling](#) is *historyHandling*, and [has cross-origin redirects](#) is *hasCrossOriginRedirects*.
20. Run [process a navigate response](#) with *navigationType*, *allowedToDownload*, *hasTransientActivation*, and *navigationParams*.

To [process a navigate response](#), given a string *navigationType*, a boolean *allowedToDownload*, a boolean *hasTransientActivation*, and a [navigation params](#) *navigationParams*:

1. Let *response* be *navigationParams*'s [response](#).
2. Let *browsingContext* be *navigationParams*'s [browsing context](#).
3. Let *failure* be false.
4. If *response* is a [network error](#), then set *failure* to true.

Otherwise, if the result of [Should navigation response to navigation request of type in target be blocked by Content Security Policy?](#) given *navigationParams*'s [request](#), *response*, *navigationParams*'s [policy container](#)'s [CSP list](#), *navigationType*, and *browsingContext* is "Blocked", then set *failure* to true. [\[CSP\]](#)

Otherwise, if *navigationParams*'s [reserved environment](#) is non-null and the result of

[checking a navigation response's adherence to its embedder policy](#) given *response*, *browsingContext*, and *navigationParams*'s [policy container](#)'s [embedder policy](#) is false, then set *failure* to true.

Otherwise, if the result of [checking a navigation response's adherence to 'X-Frame-Options'](#) given *response*, *browsingContext*, and *navigationParams*'s [origin](#) is false, then set *failure* to true.

5. If *failure* is true, then:

1. [Display the inline content with an appropriate error shown to the user](#) given *browsingContext*.
2. Run the [environment discarding steps](#) for *navigationParams*'s [reserved environment](#).
3. Invoke [WebDriver BiDi navigation failed](#) with *browsingContext* and a new [WebDriver BiDi navigation status](#) whose [id](#) is *navigationParams*'s [id](#), [status](#) is "[canceled](#)", and [url](#) is *response*'s [URL](#).
4. Return.

This is where the network errors defined and propagated by *Fetch*, such as DNS or TLS errors, end up being displayed to users. [\[FETCH\]](#)

6. If *response*'s [status](#) is 204 or 205, then return.

7. If *response* has a '[Content-Disposition](#)' header specifying the **attachment** disposition type, then:

1. If [allowedToDownload](#) is true, then handle *response* [as a download](#).
2. Invoke [WebDriver BiDi download started](#) with *browsingContext* and a new [WebDriver BiDi navigation status](#) whose [id](#) is *navigationParams*'s [id](#), [status](#) is "[complete](#)", and [url](#) is *response*'s [URL](#).
3. Return.

8. Let *type* be the [computed type of \*response\*](#).

9. If the user agent has been configured to process resources of the given *type* using some mechanism other than rendering the content in a [browsing context](#), then skip this step. Otherwise, if the *type* is one of the following types, jump to the appropriate entry in the following list, and process *response* as described there:

an [HTML MIME type](#)

Follow the steps given in the [HTML document](#) section providing *navigationParams*. Once the steps have completed, return.

an [XML MIME type](#) that is not an [explicitly supported XML MIME type](#)

Follow the steps given in the [XML document](#) section providing *navigationParams* and *type*. Once the steps have completed, return.

a [JavaScript MIME type](#)

a [JSON MIME type](#) that is not an [explicitly supported JSON MIME type](#)

["text/css"](#)

["text/plain"](#)

["text/vtt"](#)

Follow the steps given in the [plain text file](#) section providing *navigationParams* and *type*. Once the steps have completed, return.

["multipart/x-mixed-replace"](#)

Follow the steps given in the [multipart/x-mixed-replace](#) section providing *navigationParams*. Once the steps have completed, return.

A supported image, video, or audio type

Follow the steps given in the [media](#) section providing *navigationParams* and *type*.

Once the steps have completed, return.

["application/pdf"](#)

["text/pdf"](#)

If the user agent's [PDF viewer supported](#) is true, then either follow the steps given in the [plugin](#) section providing *navigationParams* and *type*, or [display the inline content](#) given *browsingContext*. Once the steps have completed, return.

See [issue #6003](#) for discussion on picking one of these two behaviors to standardize.

Otherwise, proceed onward.

An *explicitly supported XML MIME type* is an [XML MIME type](#) for which the user agent is configured to use an external application to render the content (either a [plugin](#) rendering directly in *browsingContext*, or a separate application), or one for which the user agent has dedicated processing rules (e.g., a web browser with a built-in Atom feed viewer would be said to explicitly support the [application/atom+xml](#) MIME type), or one for which the user agent has a dedicated handler.

An *explicitly supported JSON MIME type* is a [JSON MIME type](#) for which the user agent is configured to use an external application to render the content (either a [plugin](#) rendering directly in *browsingContext*, or a separate application), or one for which the user agent has dedicated processing rules, or one for which the user agent has a dedicated handler.

10. If, given *type*, the new resource is to be handled by displaying some sort of inline content, e.g., a native rendering of the content or an error message because the specified type is not supported, then [display the inline content](#) given *browsingContext*, and then return.

11. Otherwise, the document's *type* is such that the resource will not affect *browsingContext*, e.g., because the resource is to be handed to an external application or because it is an unknown type that will be processed [as a download](#). [Hand-off to external software](#) given *response*, *browsingContext*, *navigationParams*'s [final sandboxing flag set](#), and *hasTransientActivation*.

To process a *navigate URL scheme*, given a [URL](#) *url*, a [browsing context](#) *browsingContext*, a [sandboxing flag set](#) *sandboxFlags*, and a boolean *hasTransientActivation*:

1. If *url* is to be handled using a mechanism that does not affect *browsingContext*, e.g., because *url*'s [scheme](#) is handled externally, then [hand-off to external software](#) given *url*, *browsingContext*, *sandboxFlags*, and *hasTransientActivation*.
2. Otherwise, *url* is to be handled by displaying some sort of inline content, e.g., an error message because the specified scheme is not one of the supported protocols, or an inline prompt to allow the user to select [a registered handler](#) for the given scheme. [Display the inline content](#) given *browsingContext*.

In the case of a registered handler being used, [navigate](#) will be invoked with a new URL.

To *hand-off to external software* given a [URL](#) or [response](#) resource, a [browsing context](#) *browsingContext*, a [sandboxing flag set](#) *sandboxFlags*, and a boolean *hasTransientActivation*, user agents should:

1. If *browsingContext* is not a [top-level browsing context](#), and none of:
  - *sandboxFlags* contains the [allow-top-navigation-by-user-activation](#) token and *hasTransientActivation* is true
  - *sandboxFlags* contains the [allow-top-navigation](#) token
  - *sandboxFlags* contains the [allow-popups](#) token

hold, then return without invoking the external software package.

Navigation inside an iframe toward external software can be seen by users as a new popup or a new top-level navigation. Therefore, we enforcing sandbox flags appropriately.

2. Perform the appropriate handoff of *resource* while attempting to mitigate the risk that this is an attempt to exploit the target software. For example, user agents could prompt the user to confirm that the [source browsing context](#)'s [active document](#)'s [origin](#) is to be allowed to invoke the external software in question. In particular, if *hasTransientActivation* is false, then the user agent should not invoke the external software package without prior user confirmation.

For example, there could be a vulnerability in the target software's URL handler which a hostile page would attempt to exploit by tricking a user into clicking a link.

To execute a *javascript:* URL request, given a [request](#) request, a [browsing context](#) `browsingContext`, and an [origin](#) `initiatorOrigin`:

1. Let `response` be a [response](#) whose [status](#) is **204**.
2. If both of the following are true:
  - `initiatorOrigin` is [same origin-domain](#) with `browsingContext`'s [active document's origin](#).
  - The result of [Should navigation request of type be blocked by Content Security Policy?](#) given `request` and `navigationType` is "Allowed". [\[CSP\]](#)

then:

1. Let `urlString` be the result of running the [URL serializer](#) on `request`'s [URL](#).
2. Let `encodedScriptSource` be the result of removing the leading "`javascript:`" from `urlString`.
3. Let `scriptSource` be the [UTF-8 decoding](#) of the [percent-decoding](#) of `encodedScriptSource`.
4. [Append](#) `browsingContext`'s [active document](#)'s [URL](#) to `request`'s [URL list](#).
5. Let `settings` be `browsingContext`'s [active document](#)'s [relevant settings object](#).
6. Let `baseURL` be `settings`'s [API base URL](#).
7. Let `script` be the result of [creating a classic script](#) given `scriptSource`, `settings`, `baseURL`, and the [default classic script fetch options](#).
8. Let `evaluationStatus` be the result of [running the classic script](#) `script`.
9. Let `result` be undefined if `evaluationStatus` is an [abrupt completion](#) or `evaluationStatus.[[Value]]` is empty, or `evaluationStatus.[[Value]]` otherwise.
10. If [Type\(result\)](#) is String, then set `response` to a [response](#) whose [header list](#) is « `('Content-Type', 'text/html; charset=utf-8')` », and whose [body](#) is the result of [UTF-8 encoding](#) `result`.

The encoding to UTF-8 means that unpaired [surrogates](#) will not roundtrip, once the HTML parser decodes the response body.

3. Return `response`.

In addition to the specific issues linked above, [javascript:](#) URLs have a [dedicated label](#) on the issue tracker documenting various problems with their specification.

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Some of the sections below, to which the above algorithm defers in certain cases, use the following steps to *create and initialize a Document object*, given a [type type](#), [content type contentType](#), and [navigation params navigationParams](#):

1. Let *browsingContext* be the result of the [obtaining a browsing context to use for a navigation response](#) given *navigationParams*'s [browsing context](#), *navigationParams*'s [final sandboxing flag set](#), *navigationParams*'s [cross-origin opener policy](#), and *navigationParams*'s [COOP enforcement result](#).
2. Let *permissionsPolicy* be the result of [creating a permissions policy from a response](#) given *browsingContext*, *navigationParams*'s [origin](#), and *navigationParams*'s [response \[PERMISSIONSPOLICY\]](#)

The [creating a permissions policy from a response](#) algorithm makes use of the passed [origin](#). If [document.domain](#) has been used for *browsingContext*'s [container document](#), then its [origin](#) cannot be [same origin-domain](#) with the passed [origin](#), because these steps run before the *document* is created, so it cannot itself yet have used [document.domain](#). Note that this means that Permissions Policy checks are less permissive compared to doing a [same origin](#) check instead.

See below for some examples of this in action.

3. Let *creationURL* be *navigationParams*'s [response's URL](#).
4. If *navigationParams*'s [request](#) is non-null, then set *creationURL* to *navigationParams*'s [request's current URL](#).
5. If *browsingContext* is still on its initial [about:blank Document](#), and *navigationParams*'s [history handling](#) is "[replace](#)", and *browsingContext*'s [active document](#)'s [origin](#) is [same origin-domain](#) with *navigationParams*'s [origin](#), then do nothing.

This means that both the [initial about:blank Document](#), and the new [Document](#) that is about to be created, will share the same [Window](#) object.

6. Otherwise:
  1. Let *oacHeader* be the result of [getting a structured field value](#) given '[Origin-Agent-Cluster](#)' and "item" from *response*'s [header list](#).
  2. Let *requestsOAC* be true if *oacHeader* is not null and *oacHeader[0]* is the [boolean](#) true; otherwise false.
  3. If *navigationParams*'s [reserved environment](#) is a [non-secure context](#), then set *requestsOAC* to false.

4. Let *agent* be the result of [obtaining a similar-origin window agent](#) given *navigationParams*'s [origin](#), *browsingContext*'s [group](#), and *requestsOAC*.
5. Let *realm execution context* be the result of [creating a new JavaScript realm](#) given *agent* and the following customizations:
  - For the global object, create a new [Window](#) object.
  - For the global `this` binding, use *browsingContext*'s [WindowProxy](#) object.
6. Let *topLevelCreationURL* be *creationURL*.
7. Let *topLevelOrigin* be *navigationParams*'s [origin](#).
8. If *browsingContext* is not a [top-level browsing context](#), then:
  1. Let *parentEnvironment* be *browsingContext*'s [container](#)'s [relevant settings object](#).
  2. Set *topLevelCreationURL* to *parentEnvironment*'s [top-level creation URL](#).
  3. Set *topLevelOrigin* to *parentEnvironment*'s [top-level origin](#).
9. [Set up a window environment settings object](#) with *creationURL*, *realm execution context*, *navigationParams*'s [reserved environment](#), *topLevelCreationURL*, and *topLevelOrigin*.

This is the usual case, where the new [Document](#) we're about to create gets a new [Window](#) to go along with it.

7. Let *document* be a new [Document](#), whose [type](#) is *type*, [content type](#) is *contentType*, [origin](#) is *navigationParams*'s [origin](#), [policy container](#) is *navigationParams*'s [policy container](#), [permissions policy](#) is *permissionsPolicy*, [active sandboxing flag set](#) is *navigationParams*'s [final sandboxing flag set](#), and [cross-origin opener policy](#) is *navigationParams*'s [cross-origin opener policy](#), and [navigation id](#) is *navigationParams*'s [id](#).

The new [Window](#)'s [associated Document](#) is set to *document* later, when the caller of this algorithm [updates the session history with the new page](#). That algorithm [sets the active document](#) as part of its larger role of synchronizing the [Window](#), [Document](#), [browsing context](#), and [session history](#).

8. Set *document*'s [URL](#) to *creationURL*.
9. Set *document*'s [current document readiness](#) to "loading".

10. Run CSP initialization for a [Document](#) given *document*. [\[CSP\]](#)
11. If *navigationParams*'s [request](#) is non-null, then:
  1. Set *document*'s [referrer](#) to the empty string.
  2. Let *referrer* be *navigationParams*'s [request](#)'s [referrer](#).
  3. If *referrer* is a [URL record](#), then set *document*'s [referrer](#) to the [serialization](#) of *referrer*.

Per *Fetch*, *referrer* will be either a [URL record](#) or "no-referrer" at this point.
12. Set *document*'s [load timing info](#) to a new [document load timing info](#).
13. Let *historyHandling* be *navigationParams*'s [history handling](#).
14. Let *navigationType* be the result of switching on *navigationParams*'s [history handling](#):

  - ["default"](#)
  - ["replace"](#)
  - ["navigate"](#)
  - ["reload"](#)
  - ["reload"](#)
  - ["entry update"](#)
  - ["back\\_forward"](#)

15. Let *redirectCount* be 0 if *navigationParams*'s [has cross-origin redirects](#) is true; otherwise *navigationParams*'s [request's redirect count](#).
16. Create the [navigation timing entry](#) for *document*, with *navigationParams*'s [response's timing info](#), [response's service worker timing info](#), [redirectCount](#), and *navigationType*.
17. If *navigationParams*'s [response](#) has a 'Refresh' header, then:
  1. Let *value* be the [isomorphic decoding](#) of the value of the header.
  2. Run the [shared declarative refresh steps](#) with *document* and *value*.

We do not currently have a spec for how to handle multiple 'Refresh' headers. This is tracked as [issue #2900](#).
18. Return *document*.

In this example, the child document is not allowed to use [PaymentRequest](#), despite being [same origin-domain](#) at the time the child document tries to use it. At the time the child

document is initialized, only the parent document has set [document.domain](#), and the child document has not.

```
<!-- https://foo.example.com/a.html -->
<!doctype html>
<script>
document.domain = 'example.com';
</script>
<iframe src=b.html></iframe>

<!-- https://bar.example.com/b.html -->
<!doctype html>
<script>
document.domain = 'example.com'; // This happens after the document is initialized
new PaymentRequest(...); // Not allowed to use
</script>
```

In this example, the child document *is* allowed to use [PaymentRequest](#), despite not being [same origin-domain](#) at the time the child document tries to use it. At the time the child document is initialized, none of the documents have set [document.domain](#) yet so [same origin-domain](#) falls back to a normal [same origin](#) check.

```
<!-- https://example.com/a.html -->
<!doctype html>
<iframe src=b.html></iframe>
<!-- The child document is now initialized, before the script below is run. -->
<script>
document.domain = 'example.com';
</script>

<!-- https://example.com/b.html -->
<!doctype html>
<script>
new PaymentRequest(...); // Allowed to use
</script>
```

Some of the sections below, to which the above algorithm defers in certain cases, require the user agent to *update the session history with the new page*, given some [navigation params](#) `navigationParams` and a [Document](#) `newDocument`. When a user agent is required to do this, it must [queue a global task](#) on the [networking task source](#), given the [relevant global object](#) of the [Document](#) object of the [current entry](#) (not the new one), to run the following steps:

1. Let `sessionHistory` be `navigationParams`'s [browsing context](#)'s [session history](#).
2. Let `unloadTimingInfo` be a new [document unload timing info](#).
3. Let `previousDocument` be `sessionHistory`'s [current entry](#)'s [document](#).

4. Unload *previousDocument* with *unloadTimingInfo*.

If this instance of the [navigation](#) algorithm is canceled while this step is running the [unload a document](#) algorithm, then the [unload a document](#) algorithm must be allowed to run to completion, but this instance of the [navigation](#) algorithm must not run beyond this step. (In particular, for instance, the cancelation of this algorithm does not abort any event dispatch or script execution occurring as part of unloading the document or its descendants.)

5. If *navigationParams*'s [has cross-origin redirects](#) is false, and *newDocument*'s [origin](#) is the [same](#) as *previousDocument*'s [origin](#), then set *newDocument*'s [previous document unload timing](#) to *unloadTimingInfo*.
6. Switch on *navigationParams*'s [history handling](#):

#### ["entry update"](#)

##### ["reload"](#)

1. Let *oldDocument* be *sessionHistory*'s [current entry's document](#).
2. [For each](#) entry of *sessionHistory*: if entry's [document](#) is *oldDocument*, then set entry's [document](#) to *newDocument*.
3. [Traverse the history](#) to *sessionHistory*'s [current entry](#) with [historyHandling](#) set to *navigationParams*'s [history handling](#).

#### ["replace"](#)

1. Let *newEntry* be a new [session history entry](#) whose [URL](#) is *newDocument*'s [URL](#) and [document](#) is *newDocument*.

Some browsers copy over the serialized state *sessionHistory*'s [current entry](#) in cases where its [URL equals](#) that of *newDocument*, but this is inconsistent. See [issue #6213](#) for more discussion on this.

2. If *newDocument*'s [URL requires storing the policy container in history](#), set *newEntry*'s [policy container](#) to *navigationParams*'s [policy container](#).
3. Insert *newEntry* into *sessionHistory* after its [current entry](#).
4. [Traverse the history](#) to *newEntry* with [historyHandling](#) set to "[replace](#)".

#### ["default"](#)

1. Remove all the entries in *sessionHistory* after its [current entry](#). (If the [current entry](#) is the last entry in the session history, then no entries are removed.)

This [doesn't necessarily have to affect](#) the user agent's user interface.

2. Let *newEntry* be a new [session history entry](#) whose [URL](#) is *newDocument*'s [URL](#) and [document](#) is *newDocument*.
  3. If *newDocument*'s [URL requires storing the policy container in history](#), then set *newEntry*'s [policy container](#) to *navigationParams*'s [policy container](#).
  4. [Append](#) *newEntry* to *sessionHistory*.
  5. [Traverse the history](#) to *newEntry*.
7. The [navigation algorithm](#) has now *matured*.
  8. [Try to scroll to the fragment](#) for *newDocument*.

To [try to scroll to the fragment](#) for a [Document](#) document, perform the following steps [in parallel](#):

1. Wait for an [implementation-defined](#) amount of time. (This is intended to allow the user agent to optimize the user experience in the face of performance concerns.)
2. [Queue a global task](#) on the [networking task source](#) given *document*'s [relevant global object](#) to run these steps:
  1. If *document* has no parser, or its parser has [stopped parsing](#), or the user agent has reason to believe the user is no longer interested in scrolling to the [fragment](#), then abort these steps.
  2. [Scroll to the fragment](#) given in *document*'s [URL](#). If this does not find [an indicated part of the document](#), then [try to scroll to the fragment](#) for *document*.

### 7.11.2 Page load processing model for HTML files

When [an HTML document is to be loaded](#), given [navigation params](#) *navigationParams*, the user agent must [queue a task](#) on the [networking task source](#) to:

1. Let *document* be the result of [creating and initializing a Document object](#) given "[html](#)", "[text/html](#)", and *navigationParams*.
2. Create an [HTML parser](#) and associate it with the *document*. Each [task](#) that the [networking task source](#) places on the [task queue](#) while fetching runs must then fill the parser's [input byte stream](#) with the fetched bytes and cause the [HTML parser](#) to perform the appropriate processing of the input stream.

The [input byte stream](#) converts bytes into characters for use in the [tokenizer](#). This process relies, in part, on character encoding information found in the real [Content-Type metadata](#) of the resource; the computed type is not used for this purpose.

When no more bytes are available, the user agent must [queue a global task](#) on the [networking task source](#) given the newly-created [Document](#)'s [relevant global object](#) for the parser to process the implied EOF character, which eventually causes a [load](#) event to be fired.

After creating the [Document](#) object, but before any script execution, certainly before the parser [stops](#), the user agent must [update the session history with the new page](#) given [navigationParams](#) and the newly-created [Document](#).

### 7.11.3 Page load processing model for XML files

When faced with displaying an XML file inline, provided [navigation params](#) [navigationParams](#) and a string [type](#), user agents must follow the requirements defined in *XML* and *Namespaces in XML*, *XML Media Types*, *DOM*, and other relevant specifications to [create and initialize a Document object](#) [document](#), given "xml", [type](#), and [navigationParams](#). They must also create a corresponding [XML parser](#). [\[XML\]](#) [\[XMLNS\]](#) [\[RFC7303\]](#) [\[DOM\]](#)

At the time of writing, the XML specification community had not actually yet specified how XML and the DOM interact.

The actual HTTP headers and other metadata, not the headers as mutated or implied by the algorithms given in this specification, are the ones that must be used when determining the character encoding according to the rules given in the above specifications. Once the character encoding is established, the [document's character encoding](#) must be set to that character encoding.

Then, with [document](#), the user agent must [update the session history with the new page](#) given [navigationParams](#) and [document](#). User agents may do this before the complete document has been parsed (thus achieving *incremental rendering*), and must do this before any scripts are to be executed.

Once parsing is complete, the user agent must set [document's navigation id](#) to null.

For HTML documents this is reset when parsing is complete, after firing the [load](#) event.

Error messages from the parse process (e.g., XML namespace well-formedness errors) may be reported inline by mutating the [Document](#).

### 7.11.4 Page load processing model for text files

When a plain text document is to be loaded, provided [navigation params](#) [navigationParams](#) and a string [type](#), the user agent must [queue a task](#) on the [networking task source](#) to:

1. Let [document](#) be the result of [creating and initializing a Document object](#) given "html", [type](#), and [navigationParams](#).
2. Set [document's parser cannot change the mode flag](#) to true.

3. Set *document*'s [mode](#) to "no-quirks".
4. Create an [HTML parser](#) and associate it with the *document*. Act as if the tokenizer had emitted a start tag token with the tag name "pre" followed by a single U+000A LINE FEED (LF) character, and switch the [HTML parser](#)'s tokenizer to the [PLAINTEXT state](#). Each [task](#) that the [networking task source](#) places on the [task queue](#) while fetching runs must then fill the parser's [input byte stream](#) with the fetched bytes and cause the [HTML parser](#) to perform the appropriate processing of the input stream.

The rules for how to convert the bytes of the plain text document into actual characters, and the rules for actually rendering the text to the user, are defined by the specifications for the [computed MIME type](#) of the resource (i.e., *type*).

The [document's character encoding](#) must be set to the character encoding used to decode the document.

When no more bytes are available, the user agent must [queue a global task](#) on the [networking task source](#) given the newly-created [Document](#)'s [relevant global object](#) for the parser to process the implied EOF character, which eventually causes a [load](#) event to be fired.

After creating the [Document](#) object, but potentially before the page has finished parsing, the user agent must [update the session history with the new page](#) given *navigationParams* and the newly-created [Document](#).

User agents may add content to the [head](#) element of the [Document](#), e.g., linking to a style sheet, providing script, or giving the document a [title](#).

In particular, if the user agent supports the **Format=Flowed** feature of RFC 3676 then the user agent would need to apply extra styling to cause the text to wrap correctly and to handle the quoting feature. This could be performed using, e.g., a CSS extension.

#### **7.11.5 Page load processing model for *multipart/x-mixed-replace* resources**

When a resource with the type [multipart/x-mixed-replace](#) is to be loaded in a [browsing context](#), the user agent must parse the resource using the rules for multipart types. [\[RFC2046\]](#)

This algorithm is passed [navigation params](#), but it's unclear how exactly to use them.

For each body part obtained from the resource, the user agent must run [process a navigate response](#) using the new body part and the same [browsing context](#), with [history handling](#) set to "[replace](#)" if a previous body part from the same resource resulted in a [creating and initializing a Document object](#), and otherwise using the same setup as the [navigate](#) attempt that caused this section to be invoked in the first place.

For the purposes of algorithms processing these body parts as if they were complete stand-alone resources, the user agent must act as if there were no more bytes for those resources whenever the boundary following the body part is reached.

Thus, [load](#) events (and for that matter [unload](#) events) do fire for each body part loaded.

#### 7.11.6 Page load processing model for media

When an image, video, or audio resource is to be loaded, provided [navigation params](#) `navigationParams` and a string `type`, the user agent should:

1. Let `document` be the result of [creating and initializing a Document object](#) given "html", `type`, and `navigationParams`.
2. Set `document's mode` to "no-quirks".
3. Append an [html](#) element to `document`.
4. Append a [head](#) element to the [html](#) element.
5. Append a [body](#) element to the [html](#) element.
6. Append an element *host element* for the media, as described below, to the [body](#) element.
7. Set the appropriate attribute of the element *host element*, as described below, to the address of the image, video, or audio resource.

The element *host element* to create for the media is the element given in the table below in the second cell of the row whose first cell describes the media. The appropriate attribute to set is the one given by the third cell in that same row.

Type of media	Element for the media	Appropriate attribute
Image	<a href="#">img</a>	<a href="#">src</a>
Video	<a href="#">video</a>	<a href="#">src</a>
Audio	<a href="#">audio</a>	<a href="#">src</a>

After creating the [Document](#) object, but potentially before the page has finished fully loading, the user agent must [update the session history with the new page](#) given `navigationParams` and the newly-created [Document](#).

User agents may add content to the [head](#) element of the [Document](#), or attributes to the element *host element*, e.g., to link to a style sheet, to provide a script, to give the document a [title](#), or to make the media [autoplay](#).

#### 7.11.7 Page load processing model for content that uses plugins

When a resource that requires an external resource to be rendered is to be loaded, provided

[navigation params](#) *navigationParams* and a string *type*, the user agent should:

1. Let *document* be the result of [creating and initializing a Document object](#) given "html", *type*, and *navigationParams*.
2. Set *document*'s [mode](#) to "no-quirks".
3. Mark *document* as being a *plugin document*
4. Append an [html](#) element to *document*.
5. Append a [head](#) element to the [html](#) element.
6. Append a [body](#) element to the [html](#) element.
7. Append an [embed](#) to the [body](#) element.
8. Set the [src](#) attribute of the [embed](#) element to the address of the resource.

The term [plugin document](#) is used by *Content Security Policy* as part of the mechanism that ensures [iframes](#) can't be used to evade [plugin-types](#) directives. [\[CSP\]](#)

Then, the user agent must act as if it had [stopped parsing](#).

After creating the [Document](#) object, but potentially before the page has finished fully loading, the user agent must [update the session history with the new page](#) given *navigationParams* and the newly-created [Document](#).

User agents may add content to the [head](#) element of the [Document](#), or attributes to the [embed](#) element, e.g. to link to a style sheet or to give the document a [title](#).

If the [Document](#)'s [active sandboxing flag set](#) has its [sandboxed plugins browsing context flag set](#), the synthesized [embed](#) element will [fail to render the content](#).

#### 7.11.8 Page load processing model for inline content that doesn't have a DOM

When the user agent is to display a user agent page inline, provided a [browsing context](#) *browsingContext*, the user agent should:

1. Let *navigationParams* be a new [navigation params](#) whose [request](#) is null, [response](#) is null, [origin](#) is a new [opaque origin](#), [final sandboxing flag set](#) is an empty set, [cross-origin opener policy](#) is a new [cross-origin opener policy](#), [COOP enforcement result](#) is a new [cross-origin opener policy enforcement result](#), [reserved environment](#) is null, and [browsing context](#) is *browsingContext*.

The algorithm called in the next step is not prepared to deal with a null [response](#). Probably we should synthesize one instead.

2. Let *document* be the result of [creating and initializing a Document object](#) given "html", "text/html", and *navigationParams*.
3. Set *document*'s [mode](#) to "no-quirks".
4. Either associate *document* with a custom rendering that is not rendered using the normal [Document](#) rendering rules, or mutate *document* until it represents the content the user agent wants to render.

Once the page has been set up, the user agent must act as if it had [stopped parsing](#).

After creating the [Document](#) object, but potentially before the page has been completely set up, the user agent must [update the session history with the new page](#) given *navigationParams* and the newly-created [Document](#).

#### 7.11.9 Navigating to a fragment

To [navigate to a fragment](#) given a [browsing context](#) *browsingContext*, a [URL](#) *url*, a [history handling behavior](#) *historyHandling*, and a [navigation id](#) *navigationId*:

1. If *historyHandling* is not "[replace](#)", then remove all the entries in *browsingContext*'s [session history](#) after the [current entry](#). (If the [current entry](#) is the last entry in the session history, then no entries are removed.)  
This [doesn't necessarily have to affect](#) the user agent's user interface.
2. Remove any [tasks](#) queued by the [history traversal task source](#) that are associated with any [Document](#) objects in *browsingContext*'s [top-level browsing context](#)'s [document family](#).
3. Append a new [session history entry](#) to the [session history](#) whose [URL](#) is *url*, [document](#) is the [current entry](#)'s [document](#), [policy container](#) is the [current entry](#)'s [policy-container](#) and [scroll restoration mode](#) is the [current entry](#)'s [scroll restoration mode](#).
4. [Traverse the history](#) to the new entry, with [historyHandling](#) set to *historyHandling* and with [nonBlockingEvents](#) set to true. This will [scroll to the fragment](#) given in what is now the document's [URL](#).
5. Invoke [WebDriver BiDi fragment navigated](#) with *browsingContext*, and a new [WebDriver BiDi navigation status](#) whose [id](#) is *navigationId*, [url](#) is resource's [url](#), and [status](#) is "[complete](#)".

If the scrolling fails because the relevant [ID](#) has not yet been parsed, then the original [navigation](#) algorithm will take care of the scrolling instead, as the last few steps of its [update the session history with the new page](#) algorithm.

---

When the user agent is required to *scroll to the fragment* and [the indicated part of the document](#), if any, is [being rendered](#), the user agent must either change the scrolling position of the document using the following algorithm, or perform some other action such that [the indicated part of the document](#) is brought to the user's attention. If there is no indicated part, or if the indicated part is not [being rendered](#), then the user agent must do nothing. The aforementioned algorithm is as follows:

1. If there is no [indicated part of the document](#), set the [Document](#)'s [target element](#) to null.
2. If the [indicated part of the document](#) is the top of the document, then:
  1. Set the [Document](#)'s [target element](#) to null.
  2. [Scroll to the beginning of the document](#) for the [Document](#). [\[CSSOMVIEW\]](#)
3. Otherwise:
  1. Let *target* be element that is [the indicated part of the document](#).
  2. Set the [Document](#)'s [target element](#) to *target*.
  3. Run the [ancestor details revealing algorithm](#) on *target*.
  4. [Scroll \*target\* into view](#), with *behavior* set to "auto", *block* set to "start", and *inline* set to "nearest". [\[CSSOMVIEW\]](#)
  5. Run the [focusing steps for \*target\*](#), with the [Document](#)'s [viewport](#) as the *fallback target*.
  6. Move the [sequential focus navigation starting point](#) to *target*.

*The indicated part of the document* is the one that the [fragment](#), if any, identifies. The semantics of the [fragment](#) in terms of mapping it to a node is defined by the specification that defines the [MIME type](#) used by the [Document](#) (for example, the processing of [fragments](#) for [XML MIME types](#) is the responsibility of RFC7303). [\[RFC7303\]](#)

There is also a *target element* for each [Document](#), which is used in defining the [:target](#) pseudo-class and is updated by the above algorithm. It is initially null.

For HTML documents (and [HTML MIME types](#)), the following processing model must be followed to determine what [the indicated part of the document](#) is.

1. Let *fragment* be the document's [URL](#)'s [fragment](#).
2. If *fragment* is the empty string, then [the indicated part of the document](#) is the top of the document; return.
3. If [find a potential indicated element](#) with *fragment* returns non-null, then the return

value is [the indicated part of the document](#); return.

4. Let *fragmentBytes* be the result of [percent-decoding](#) *fragment*.
5. Let *decodedFragment* be the result of running [UTF-8 decode without BOM](#) on *fragmentBytes*.
6. If [find a potential indicated element](#) with *decodedFragment* returns non-null, then the return value is [the indicated part of the document](#); return.
7. If *decodedFragment* is an [ASCII case-insensitive](#) match for the string **top**, then [the indicated part of the document](#) is the top of the document; return.
8. There is no [indicated part of the document](#).

To *find a potential indicated element* given a string *fragment*, run these steps:

1. If there is an element [in the document tree](#) that has an [ID](#) equal to *fragment*, then return the first such element in [tree order](#).
2. If there is an [a](#) element [in the document tree](#) that has a [name](#) attribute whose value is equal to *fragment*, then return the first such element in [tree order](#).
3. Return null.

#### 7.11.10 History traversal

To *traverse the history* to a [session history entry](#) entry, with an optional [history handling behavior](#) *historyHandling* (default "[default](#)"), an optional boolean *nonBlockingEvents* (default false), and an optional boolean *explicitHistoryNavigation* (default false):

This algorithm is not just invoked when [explicitly going back or forwards in the session history](#) — it is also invoked in other situations, for example when [navigating a browsing context](#), as part of [updating the session history with the new page](#).

1. If *entry*'s [document](#) is null, then:
  1. Assert: *historyHandling* is "[default](#)".
  2. Let *request* be a new [request](#) whose [URL](#) is *entry*'s [URL](#).
  3. If *explicitHistoryNavigation* is true, then set *request*'s [history-navigation flag](#).
  4. [Navigate](#) the [browsing context](#) to *request* with *historyHandling* set to "[entry update](#)" and with [historyPolicyContainer](#) set to *entry*'s [policy container](#). The navigation must be done using the same [source browsing context](#) as was used the first time *entry* was created.

The “[navigate](#)” algorithm reinvokes this “traverse” algorithm to complete the traversal, at which point *entry*’s [document](#) is non-null.

If the resource was obtained using a non-idempotent action, for example a POST form submission, or if the resource is no longer available, for example because the computer is now offline and the page wasn’t cached, navigating to it again might not be possible. In this case, the navigation will result in a different page than previously; for example, it might be an error message explaining the problem or offering to resubmit the form.

5. Return.
2. [Save persisted state](#) to the [current entry](#).
3. Let *newDocument* be *entry*’s [document](#).
4. If *newDocument* is different than the [current entry](#)’s [document](#), or *historyHandling* is “[entry update](#)” or “[reload](#)”, then:
  1. If *newDocument*’s [suspended timer handles](#) is not [empty](#):
    1. Assert: *newDocument*’s [suspension time](#) is not zero.
    2. Let *suspendDuration* be the [current high resolution time](#) minus *newDocument*’s [suspension time](#).
    3. Let *activeTimers* be *newDocument*’s [relevant global object](#)’s [map of active timers](#).
    4. For each *handle* in *newDocument*’s [suspended timer handles](#), if *activeTimers[handle]* [exists](#), then increase *activeTimers[handle]* by *suspendDuration*.
  2. Remove any [tasks](#) queued by the [history traversal task source](#) that are associated with any [Document](#) objects in the [top-level browsing context](#)’s [document family](#).
  3. If *newDocument*’s [origin](#) is not [same origin](#) with the [current entry](#)’s [document](#)’s [origin](#), then:
    1. Let *entriesToUpdate* be all [entries](#) in the [session history](#) whose [document](#)’s [origin](#) is [same origin](#) as the [active document](#) and that are contiguous with the [current entry](#).
    2. [For each](#) *entryToUpdate* of *entriesToUpdate*, set *entryToUpdate*’s [browsing context name](#) to the current [browsing context name](#).
    3. If the browsing context is a [top-level browsing context](#), but not an

[auxiliary browsing context](#) whose [disowned](#) is false, then set the browsing context's [name](#) to the empty string.

4. Set the active document of the [browsing context](#) to *newDocument*.
5. If *entry*'s [browsing context name](#) is not null, then:
  1. Set the browsing context's [name](#) to *entry*'s [browsing context name](#).
  2. Let *entriesToUpdate* be all [entries](#) in the [session history](#) whose [document](#)'s [origin](#) is [same origin](#) as the new [active document](#)'s [origin](#) and that are contiguous with *entry*.
  3. [For each](#) *entryToUpdate* of *entriesToUpdate*, set *entryToUpdate*'s [browsing context name](#) to null.
6. If *newDocument* has any form controls whose [autofill field name](#) is "[off](#)", invoke the [reset algorithm](#) of each of those elements.
7. If *newDocument*'s [current document readiness](#) "complete", then [queue a global task](#) on the [DOM manipulation task source](#) given *newDocument*'s [relevant global object](#) to run the following steps:
  1. If *newDocument*'s [page showing](#) flag is true, then abort these steps.
  2. Set *newDocument*'s [page showing](#) flag to true.
  3. [Update the visibility state](#) of *newDocument* to "hidden".
  4. [Fire a page transition event](#) named [pageshow](#) at *newDocument*'s [relevant global object](#) with true.
5. Set *newDocument*'s [URL](#) to *entry*'s [URL](#).
6. Set *newDocument*'s [is initial about:blank](#) to false.

The spec currently allows keeping the [initial about:blank Document](#) in session history, but this is probably a bug: see [issue #6491](#) (and especially [this comment](#)). If we fix that then we can convert this step into an assert that *newDocument*'s [is initial about:blank](#) is false, i.e., an assert that we never traverse back to the [initial about:blank Document](#).

7. Let *hashChanged* be false, and let *oldURL* and *newURL* be null.
8. If *entry*'s [URL](#)'s [fragment](#) is not [identical to](#) the [current entry](#)'s [URL](#)'s [fragment](#), and *entry*'s [document](#) equals the [current entry](#)'s [document](#), then set *hashChanged* to true, set *oldURL* to the [current entry](#)'s [URL](#), and set *newURL* to *entry*'s [URL](#).

9. If *historyHandling* is "[replace](#)", then remove the entry immediately before *entry* in the [session history](#).
10. If *entry*'s [persisted user state](#) is null, and its [URL](#)'s [fragment](#) is non-null, then [scroll to the fragment](#).
11. Set the [current entry](#) to *entry*.
12. Let *targetRealm* be the [current Realm Record](#).
13. Let *state* be null.
14. If *entry*'s [serialized state](#) is not null, then set *state* to [StructuredDeserialize](#)(*entry*'s [serialized state](#), *targetRealm*). If this throws an exception, catch it and ignore the exception.
15. Set *newDocument*'s [History](#) object's [state](#) to *state*.
16. Let *stateChanged* be true if *newDocument* has a [latest entry](#), and that entry is not *entry*; otherwise let it be false.
17. Set *newDocument*'s [latest entry](#) to *entry*.
18. If *nonBlockingEvents* is false, then run the following steps [immediately](#). Otherwise, [queue a global task](#) on the [DOM manipulation task source](#) given *newDocument*'s [relevant global object](#) to run the following steps instead.
  1. If *stateChanged* is true, then [fire an event](#) named [popstate](#) at *newDocument*'s [relevant global object](#), using [PopStateEvent](#), with the [state](#) attribute initialized to *state*.
  2. [Restore persisted state](#) from *entry*.
  3. If *hashChanged* is true, then [fire an event](#) named [hashchange](#) at the [browsing context](#)'s [active window](#), using [HashChangeEvent](#), with the [oldURL](#) attribute initialized to *oldURL* and the [newURL](#) attribute initialized to *newURL*.

#### 7.11.10.1 Persisted history entry state

To save [persisted state](#) to a [session history entry](#) *entry*:

1. Set the [scroll position data](#) of *entry* to contain the scroll positions for all of *entry*'s [document](#)'s [restorable scrollable regions](#).
2. Optionally, update *entry*'s [persisted user state](#) to reflect any state that the user agent wishes to persist, such as the values of form fields.

To restore [persisted state](#) from a [session history entry](#) *entry*:

1. If *entry*'s [scroll restoration mode](#) is "[auto](#)", then the user agent may use *entry*'s [scroll position data](#) to restore the scroll positions of *entry*'s [document](#)'s [restorable scrollable regions](#).

The user agent not restoring scroll positions does not imply that scroll positions will be left at any particular value (e.g., (0,0)). The actual scroll position depends on the navigation type and the user agent's particular caching strategy. So web applications cannot assume any particular scroll position but rather are urged to set it to what they want it to be.

2. Optionally, update other aspects of *entry*'s [document](#) and its rendering, for instance values of form fields, that the user agent had previously recorded in *entry*'s [persisted user state](#).

This can even include updating the [dir](#) attribute of [textarea](#) elements or [input](#) elements whose [type](#) attribute is in either the [Text](#) state or the [Search](#) state, if the persisted state includes the directionality of user input in such controls.

Restoring the value of form controls as part of this process does not fire any [input](#) or [change](#) events, but can trigger the [formStateRestoreCallback](#) of [form-associated custom elements](#).

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The *restorable scrollable regions* of a [Document](#) *document* are *document*'s [viewport](#), and all of *document*'s scrollable regions excepting any [child browsing contexts](#) of *document*.

[Child browsing context](#) scroll restoration is handled by the history entry for those browsing contexts' [Document](#)s.

#### 7.11.10.2 The [PopStateEvent](#) interface



##### [PopStateEvent](#)

Support in all current engines.

Firefox 4+ Safari 6+ Chrome 4+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

[Exposed=Window]

```
interface PopStateEvent : Event {
 constructor(DOMString type, optional PopStateEventInit eventInitDict = {});
```

```
readonly attribute any state;
};

dictionary PopStateEventInit : EventInit {
 any state = null;
};
```

### **[event.state](#)**

Returns a copy of the information that was provided to [pushState\(\)](#) or [replaceState\(\)](#).

The **state** attribute must return the value it was initialized to. It represents the context information for the event, or null, if the state represented is the initial state of the [Document](#).

#### 7.11.10.3 The [HashChangeEvent](#) interface



### [HashChangeEvent](#)

Support in all current engines.

Firefox 3.6+ Safari 5+ Chrome 8+

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Opera 10.6+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 8+

---

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

```
[Exposed=Window]
interface HashChangeEvent : Event {
 constructor(DOMString type, optional HashChangeEventInit eventInitDict = {}

 readonly attribute USVString oldURL;
 readonly attribute USVString newURL;
};

dictionary HashChangeEventInit : EventInit {
 USVString oldURL = "";
 USVString newURL = "";
};
```

### **[event.oldURL](#)**



## [HashChangeEvent/oldURL](#)

Support in all current engines.

Firefox 6+ Safari 5.1+ Chrome 8+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android Yes Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [URL](#) of the [session history entry](#) that was previously current.

## **event.newURL**



## [HashChangeEvent/newURL](#)

Support in all current engines.

Firefox 6+ Safari 5.1+ Chrome 8+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android Yes Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Returns the [URL](#) of the [session history entry](#) that is now current.

The *oldURL* attribute must return the value it was initialized to. It represents context information for the event, specifically the URL of the [session history entry](#) that was traversed from.

The *newURL* attribute must return the value it was initialized to. It represents context information for the event, specifically the URL of the [session history entry](#) that was traversed to.

### 7.11.10.4 The [PageTransitionEvent](#) interface



## [PageTransitionEvent](#)

Support in all current engines.

Firefox 1.5+ Safari 5+ Chrome 4+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

---

Firefox Android4+Safari iOS4+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android14+

```
[Exposed=Window]
interface PageTransitionEvent : Event {
 constructor(DOMString type, optional PageTransitionEventInit eventInitDict);

 readonly attribute boolean persisted;
};

dictionary PageTransitionEventInit : EventInit {
 boolean persisted = false;
};

event.persisted
```



## [PageTransitionEvent/persisted](#)

Support in all current engines.

---

Firefox11+Safari5+Chrome4+

---

Opera15+Edge79+

---

Edge (Legacy)12+Internet Explorer11

---

Firefox Android14+Safari iOS4+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android14+

For the [pageshow](#) event, returns false if the page is newly being loaded (and the [load](#) event will fire). Otherwise, returns true.

For the [pagehide](#) event, returns false if the page is going away for the last time. Otherwise, returns true, meaning that the page might be reused if the user navigates back to this page (if the [Document](#)'s [salvageable](#) state stays true).

Things that can cause the page to be unsalvageable include:

- The user agent decided to not keep the [Document](#) alive in a [session history entry](#) after [unload](#)
- Having [iframe](#)s that are not [salvageable](#)
- Active [WebSocket](#) objects
- [Aborting a Document](#)

The ***persisted*** attribute must return the value it was initialized to. It represents the context information for the event.

To fire a page transition event named *eventName* at a [Window](#) *window* with a boolean

*persisted*, [fire an event](#) named *eventName* at *window*, using [PageTransitionEvent](#), with the [persisted](#) attribute initialized to *persisted*, the [cancelable](#) attribute initialized to true, the [bubbles](#) attribute initialized to true, and *legacy target override flag* set.

The values for [cancelable](#) and [bubbles](#) don't make any sense, since canceling the event does nothing and it's not possible to bubble past the [Window](#) object. They are set to true for historical reasons.

### 7.11.11 Loading documents

A [Document](#) has a *completely loaded time* (a time or null), which is initially null.

A [Document](#) is considered *completely loaded* if its [completely loaded time](#) is non-null.

To *completely finish loading* a [Document](#) document:

1. Assert: *document*'s [browsing context](#) is non-null.
2. Set *document*'s [completely loaded time](#) to the current time.
3. Let *container* be *document*'s [browsing context](#)'s [container](#).

This will be null in the case where *document* is the [initial about:blank Document](#) in a [frame](#) or [iframe](#), since at the point of [browsing context creation](#) which calls this algorithm, the container relationship has not yet been established. (That happens in a subsequent step of [create a new nested browsing context](#).)

The consequence of this is that the following steps do nothing, i.e., we do not fire an asynchronous [load](#) event on the container element for such cases. Instead, a synchronous [load](#) event is fired in a special initial-insertion case in the [shared attribute processing steps for iframe and frame elements](#).

4. If *container* is an [iframe](#) element, then [queue an element task](#) on the [DOM manipulation task source](#) given *container* to run the [iframe load event steps](#) given *container*.
5. Otherwise, if *container* is non-null, then [queue an element task](#) on the [DOM manipulation task source](#) given *container* to [fire an event](#) named [load](#) at *container*.

### 7.11.12 Unloading documents

A [Document](#) has a *salvageable* state, which must initially be true, and a *page showing* flag, which must initially be false. The [page showing](#) flag is used to ensure that scripts receive [pageshow](#) and [pagehide](#) events in a consistent manner (e.g. that they never receive two [pagehide](#) events in a row without an intervening [pageshow](#), or vice versa).

A [Document](#) has a [DOMHighResTimeStamp](#) *suspension time*, initially 0.

A [Document](#) has a [list](#) of *suspended timer handles*, initially empty.

[Event loops](#) have a *termination nesting level* counter, which must initially be 0.

[Document](#) objects have an *unload counter*, which is used to ignore certain operations while the below algorithms run. Initially, the counter must be set to zero.

To *prompt to unload*, given a [Document](#) object *document* and optionally a *recursiveFlag*, run these steps:

1. Increase the [event loop's termination nesting level](#) by 1.
2. Increase the *document's unload counter* by 1.
3. Let *event* be the result of [creating an event](#) using [BeforeUnloadEvent](#).
4. Initialize *event's type* attribute to [beforeunload](#) and its [cancelable](#) attribute true.
5. Dispatch: [Dispatch](#) event at *document's relevant global object*.
6. Decrease the [event loop's termination nesting level](#) by 1.
7. If all of the following are true:
  - *document's active sandboxing flag set* does not have its [sandboxed modals flag set](#)
  - *document's relevant global object* has [sticky activation](#)
  - *event's canceled flag* is set, or the [returnValue](#) attribute of *event* is not the empty string

then the user agent may ask the user to confirm that they wish to unload the document.

The message shown to the user is not customizable, but instead determined by the user agent. In particular, the actual value of the [returnValue](#) attribute is ignored.

The user agent is encouraged to avoid asking the user for confirmation if it judges that doing so would be annoying, deceptive, or pointless.

If the user agent asks the user for confirmation, it must [pause](#) while waiting for the user's response.

If the user did not confirm the page navigation, then the user agent *refused to allow the document to be unloaded*.

8. If the *recursiveFlag* is not set, then:
  1. Let *descendants* be the [list of the descendant browsing contexts](#) of *document*.
  2. For each *browsingContext* in *descendants*:
    1. [Prompt to unload](#) *browsingContext*'s [active document](#) with the *recursiveFlag* set.
    2. If the user [refused to allow the document to be unloaded](#), then the user implicitly also [refused to allow](#) *document* to be unloaded; [break](#).
9. Decrease the *document*'s [unload counter](#) by 1.

To *unload* a [Document](#) *document*, given an optional *recursiveFlag* and a [document unload timing info](#)-or-null *unloadTimingInfo* (default null):

1. Increase the [event loop](#)'s [termination nesting level](#) by one.
2. Increase *document*'s [unload counter](#) by 1.
3. If the user agent does not intend to keep *document* alive in a [session history entry](#) (such that it can be reused later on [history traversal](#)), set *document*'s [salvageable](#) state to false.
4. If *document*'s [page showing](#) flag is true:
  1. Set *document*'s [page showing](#) flag to false.
  2. [Fire a page transition event](#) named [pagehide](#) at *document*'s [relevant global object](#) with *document*'s [salvageable](#) state.
  3. [Update the visibility state](#) of *newDocument* to "hidden".
5. If *unloadTimingInfo* is not null, then set *unloadTimingInfo*'s [unload event start time](#) to the [current high resolution time](#) given *document*'s [relevant global object](#).
6. If *document*'s [salvageable](#) state is false, then [fire an event](#) named [unload](#) at *document*'s [relevant global object](#), with *legacy target override flag* set.
7. If *unloadTimingInfo* is not null, then set *unloadTimingInfo*'s [unload event end time](#) to the [current high resolution time](#) given *document*'s [relevant global object](#).
8. Decrease the [event loop](#)'s [termination nesting level](#) by one.
9. Set *document*'s [suspension time](#) to the [current high resolution time](#).
10. Set *document*'s [suspended timer handles](#) to the result of [getting the keys](#) for the [map of](#)

[active timers](#).

11. Run any [unloading document cleanup steps](#) for *document* that are defined by this specification and [other applicable specifications](#).
12. If the *recursiveFlag* is not set, then:
  1. Let *descendants* be the [list of the descendant browsing contexts](#) of *document*.
  2. For each *browsingContext* in *descendants*:
    1. [Unload](#) the [active document](#) of *browsingContext* with the *recursiveFlag* set.
    2. If the [salvageable](#) state of the [active document](#) of *browsingContext* is false, then set the [salvageable](#) state of *document* to false also.
  3. If *document*'s [salvageable](#) state is false, then [discard](#)*document*.
13. Decrease *document*'s [unload counter](#) by 1.

This specification defines the following *unloading document cleanup steps*. Other specifications can define more. Given a [Document](#) *document*:

1. Let *window* be *document*'s [relevant global object](#).
2. For each [WebSocket](#) object *webSocket* whose [relevant global object](#) is *window*, [make disappear](#) *webSocket*.  
If this affected any [WebSocket](#) objects, then set *document*'s [salvageable](#) state to false.
3. If *document*'s [salvageable](#) state is false, then:
  1. For each [EventSource](#) object *eventSource* whose [relevant global object](#) is equal to *window*, [forcibly close](#) *eventSource*.
  2. [Clear](#) *window*'s [map of active timers](#).

#### 7.11.12.1 The [BeforeUnloadEvent](#) interface



#### [BeforeUnloadEvent](#)

Support in all current engines.

Firefox 1.5+ Safari 7+ Chrome 30+

Opera17+Edge79+

---

Edge (Legacy)12+Internet Explorer4+

---

Firefox Android4+Safari iOS7+Chrome Android30+WebView Android37+Samsung Internet3.0+Opera Android18+

```
[Exposed=Window]
interface BeforeUnloadEvent : Event {
 attribute DOMString returnValue;
};
```

There are no [BeforeUnloadEvent](#)-specific initialization methods.

The [BeforeUnloadEvent](#) interface is a legacy interface which allows [prompting to unload](#) to be controlled not only by canceling the event, but by setting the [returnValue](#) attribute to a value besides the empty string. Authors should use the [preventDefault\(\)](#) method, or other means of canceling events, instead of using [returnValue](#).

The [returnValue](#) attribute controls the process of [prompting to unload](#). When the event is created, the attribute must be set to the empty string. On getting, it must return the last value it was set to. On setting, the attribute must be set to the new value.

This attribute is a [DOMString](#) only for historical reasons. Any value besides the empty string will be treated as a request to ask the user for confirmation.

#### 7.11.13 Aborting a document load

To abort a [Document](#) document:

1. Abort the [active documents](#) of every [child browsing context](#). If this results in any of those [Document](#) objects having their [salvageable](#) state set to false, then set *document's salvageable* state to false also.
2. Cancel any instances of the [fetch](#) algorithm in the context of *document*, discarding any [tasks queued](#) for them, and discarding any further data received from the network for them. If this resulted in any instances of the [fetch](#) algorithm being canceled or any [queued tasks](#) or any network data getting discarded, then set *document's salvageable* state to false.
3. If *document's navigation id* is non-null, then:
  1. Invoke [WebDriver BiDi navigation aborted](#) with *document's browsing context*, and new [WebDriver BiDi navigation status](#) whose [id](#) is *document's navigation id*, [status](#) is "[canceled](#)", and [url](#) is *document's URL*.
  2. Set *document's navigation id* to null.
4. If *document* has an [active parser](#), then:

1. Set *document*'s [active parser was aborted](#) to true.
2. [Abort that parser](#).
3. Set *document*'s [salvageable](#) state to false.

User agents may allow users to explicitly invoke the [stop document loading](#) for a [Document](#).

To *stop document loading* given a [Document](#) object *document*, run these steps:

1. Let *browsingContext* be *document*'s [browsing context](#).
2. If *browsingContext*'s [active document](#) is not *document*, then return.
3. If there is an existing attempt to [navigate](#) *browsingContext* and *document*'s [unload counter](#) is 0, then cancel that [navigation](#).
4. [Abort document](#).

#### 7.11.14 The '[X-Frame-Options](#)' header

The '[X-Frame-Options](#)' HTTP response header is a legacy way of controlling whether and how a [Document](#) may be loaded inside of a [child browsing context](#). It is obsoleted by the [frame-ancestors](#) CSP directive, which provides more granular control over the same situations. It was originally defined in *HTTP Header Field X-Frame-Options*, but the definition and processing model here supersedes that document. [\[CSP\]](#) [\[RFC7034\]](#)

In particular, *HTTP Header Field X-Frame-Options* specified an '[ALLOW-FROM](#)' variant of the header, but that is not to be implemented.

Per the below processing model, if both a CSP [frame-ancestors](#) directive and an '[X-Frame-Options](#)' header are used in the same [response](#), then '[X-Frame-Options](#)' is ignored.

For web developers and conformance checkers, its value [ABNF](#) is:

**X-Frame-Options** = "DENY" / "SAMEORIGIN"

To *check a navigation response's adherence to 'X-Frame-Options'*, given [navigationParams](#), [navigationParams](#), a [browsing context](#) *browsingContext*, and an [origin](#) *destinationOrigin*:

1. If *browsingContext* is not a [child browsing context](#), then return true.
2. [For each](#) policy of *navigationParams*'s policy container's [CSP list](#):
  1. If *policy*'s [disposition](#) is not "enforce", then [continue](#).
  2. If *policy*'s [directive set](#) contains a [frame-ancestors](#) directive, then return

true.

3. Let `rawXFrameOptions` be the result of [getting, decoding, and splitting '`X-Frame-Options`' from `navigationParams`'s `response`'s `header` list](#).
4. Let `xFrameOptions` be a new [set](#).
5. [For each](#) value of `rawXFrameOptions`, [append](#) value, [converted to ASCII lowercase](#), to `xFrameOptions`.
6. If `xFrameOptions`'s [size](#) is greater than 1, and `xFrameOptions` [contains](#) any of "deny", "allowall", or "sameorigin", then return false.

The intention here is to block any attempts at applying '[X-Frame-Options](#)' which were trying to do something valid, but appear confused.

This is the only impact of the legacy '`ALLOWALL`' value on the processing model.

7. If `xFrameOptions`'s [size](#) is greater than 1, then return true.

This means it contains multiple invalid values, which we treat the same way as if the header was omitted entirely.

8. If `xFrameOptions[0]` is "deny", then return false.
9. If `xFrameOptions[0]` is "sameorigin", then:
  1. Let `containerDocument` be `browsingContext`'s [container document](#).
  2. [While](#) `containerDocument` is not null:
    1. If `containerDocument`'s [origin](#) is not [same origin](#) with `destinationOrigin`, then return false.
    2. Let `containerBC` be `containerDocument`'s [browsing context](#).
    3. Set `containerDocument` to `containerBC`'s [container document](#), if `containerBC` is non-null; otherwise, null.
10. Return true.

If we've reached this point then we have a lone invalid value (which could potentially be one the legacy '`ALLOWALL`' or '`ALLOW-FROM`' forms). These are treated as if the header were omitted entirely.

---

The following table illustrates the processing of various values for the header, including non-conformant ones:

<b>X-Frame-Options</b>	Valid	Result
'DENY'	✓	embedding disallowed
'SAMEORIGIN'	✓	same-origin embedding allowed
'INVALID'	✗	embedding allowed
'ALLOWALL'	✗	embedding allowed
'ALLOW-FROM=https://example.com/'	✗	embedding allowed (from anywhere)

The following table illustrates how various non-conformant cases involving multiple values are processed:

<b>X-Frame-Options</b>	Result
'SAMEORIGIN, SAMEORIGIN'	same-origin embedding allowed
'SAMEORIGIN, DENY'	embedding disallowed
'SAMEORIGIN,'	embedding disallowed
'SAMEORIGIN, ALLOWALL'	embedding disallowed
'SAMEORIGIN, INVALID'	embedding disallowed
'ALLOWALL, INVALID'	embedding disallowed
'ALLOWALL,'	embedding disallowed
'INVALID, INVALID'	embedding allowed

The same results are obtained whether the values are delivered in a single header whose value is comma-delimited, or in multiple headers.

### 7.11.15 The **Refresh** header

The **Refresh** HTTP response header is the HTTP-equivalent to a [meta](#) element with an [http-equiv](#) attribute in the [Refresh state](#). It takes [the same value](#) and works largely the same. Its processing model is detailed in [create and initialize a Document object](#).

## 8 Web application APIs

### 8.1 Scripting

#### 8.1.1 Introduction

Various mechanisms can cause author-provided executable code to run in the context of a document. These mechanisms include, but are probably not limited to:

- Processing of [script](#) elements.
- Navigating to [javascript: URLs](#).
- Event handlers, whether registered through the DOM using [addEventListener\(\)](#), by explicit [event handler content attributes](#), by [event handler IDL attributes](#), or otherwise.
- Processing of technologies like SVG that have their own scripting features.

## 8.1.2 Agents and agent clusters

### 8.1.2.1 Integration with the JavaScript agent formalism

JavaScript defines the concept of an [agent](#). This section gives the mapping of that language-level concept on to the web platform.

Conceptually, the [agent](#) concept is an architecture-independent, idealized "thread" in which JavaScript code runs. Such code can involve multiple globals/[realms](#) that can synchronously access each other, and thus needs to run in a single execution thread.

Two [Window](#) objects having the same [agent](#) does not indicate they can directly access all objects created in each other's realms. They would have to be [same origin-domain](#); see [IsPlatformObjectSameOrigin](#).

The following types of agents exist on the web platform:

#### *Similar-origin window agent*

Contains various [Window](#) objects which can potentially reach each other, either directly or by using [document.domain](#).

If the encompassing [agent cluster](#)'s [is origin-keyed](#) is true, then all the [Window](#) objects will be [same origin](#), can reach each other directly, and [document.domain](#) will no-op.

Two [Window](#) objects that are [same origin](#) can be in different [similar-origin window agents](#), for instance if they are each in their own [browsing context group](#).

#### *Dedicated worker agent*

Contains a single [DedicatedWorkerGlobalScope](#).

#### *Shared worker agent*

Contains a single [SharedWorkerGlobalScope](#).

#### *Service worker agent*

Contains a single [ServiceWorkerGlobalScope](#).

#### *Worklet agent*

Contains a single [WorkletGlobalScope](#) object.

Although a given worklet can have multiple realms, each such realm needs its own agent, as each realm can be executing code independently and at the same time as the others.

Only [shared](#) and [dedicated worker agents](#) allow the use of JavaScript [Atomics](#) APIs to

potentially [block](#).

To create an agent, given a boolean *canBlock*:

1. Let *signifier* be a new unique internal value.
2. Let *candidateExecution* be a new [candidate execution](#).
3. Let *agent* be a new [agent](#) whose `[[CanBlock]]` is *canBlock*, `[[Signifier]]` is *signifier*, `[[CandidateExecution]]` is *candidateExecution*, and `[[IsLockFree1]]`, `[[IsLockFree2]]`, and `[[LittleEndian]]` are set at the implementation's discretion.
4. Set *agent*'s [event loop](#) to a new [event loop](#).
5. Return *agent*.

The relevant agent for a [platform object](#) *platformObject* is *platformObject*'s [relevant Realm](#)'s [agent](#). This pointer is not yet defined in the JavaScript specification; see [tc39/ecma262#1357](#).

The agent equivalent of the [current Realm Record](#) is the [surrounding agent](#).

#### 8.1.2.2 Integration with the JavaScript agent cluster formalism

JavaScript also defines the concept of an [agent cluster](#), which this standard maps to the web platform by placing agents appropriately when they are created using the [obtain a similar-origin window agent](#) or [obtain a worker/worklet agent](#) algorithms.

The [agent cluster](#) concept is crucial for defining the JavaScript memory model, and in particular among which [agents](#) the backing data of [SharedArrayBuffer](#) objects can be shared.

Conceptually, the [agent cluster](#) concept is an architecture-independent, idealized "process boundary" that groups together multiple "threads" ([agents](#)). The [agent clusters](#) defined by the specification are generally more restrictive than the actual process boundaries implemented in user agents. By enforcing these idealized divisions at the specification level, we ensure that web developers see interoperable behavior with regard to shared memory, even in the face of varying and changing user agent process models.

An [agent cluster](#) has an associated *cross-origin isolation mode*, which is a [cross-origin isolation mode](#). It is initially "[none](#)".

An [agent cluster](#) has an associated *is origin-keyed* (a boolean), which is initially false.

---

The following defines the allocation of the [agent clusters](#) of [similar-origin window agents](#).

An *agent cluster key* is a [site](#) or [tuple origin](#). Without web developer action to achieve [origin-keyed agent clusters](#), it will be a [site](#).

An equivalent formulation is that an [agent cluster key](#) can be a [scheme-and-host](#) or an [origin](#).

To obtain a similar-origin window agent, given an [origin](#) origin, a [browsing context group](#) group, and a boolean `requestsOAC`, run these steps:

1. Let `site` be the result of [obtaining a site](#) with `origin`.
2. Let `key` be `site`.
3. If `group`'s [cross-origin isolation mode](#) is not "[none](#)", then set `key` to `origin`.
4. Otherwise, if `group`'s [historical agent cluster key map](#)[`origin`] [exists](#), then set `key` to `group`'s [historical agent cluster key map](#)[`origin`].
5. Otherwise:
  1. If `requestsOAC` is true, then set `key` to `origin`.
  2. Set `group`'s [historical agent cluster key map](#)[`origin`] to `key`.
6. If `group`'s [agent cluster map](#)[`key`] [does not exist](#), then:
  1. Let `agentCluster` be a new [agent cluster](#).
  2. Set `agentCluster`'s [cross-origin isolation mode](#) to `group`'s [cross-origin isolation mode](#).
  3. Set `agentCluster`'s [is origin-keyed](#) to true if `key` equals `origin`; otherwise false.
  4. Add the result of [creating an agent](#), given false, to `agentCluster`.
  5. Set `group`'s [agent cluster map](#)[`key`] to `agentCluster`.
7. Return the single [similar-origin window agent](#) contained in `group`'s [agent cluster map](#)[`key`].

This means that there is only one [similar-origin window agent](#) per browsing context agent cluster. (However, [dedicated worker](#) and [worklet agents](#) might be in the same cluster.)

---

The following defines the allocation of the [agent clusters](#) of all other types of agents.

To obtain a worker/worklet agent, given an [environment settings object](#) or null `outside settings`, a boolean `isTopLevel`, and a boolean `canBlock`, run these steps:

1. Let `agentCluster` be null.
2. If `isTopLevel` is true, then:

1. Set *agentCluster* to a new [agent cluster](#).
2. Set *agentCluster*'s [is origin-keyed](#) to true.

These workers can be considered to be origin-keyed. However, this is not exposed through any APIs (in the way that [originAgentCluster](#) exposes the origin-keyedness for windows).

3. Otherwise:
  1. Assert: *outside settings* is not null.
  2. Let *ownerAgent* be *outside settings*'s [Realm](#)'s agent.
  3. Set *agentCluster* to the agent cluster which contains *ownerAgent*.
4. Let *agent* be the result of [creating an agent](#) given *canBlock*.
5. Add *agent* to *agentCluster*.
6. Return *agent*.

To obtain a dedicated/shared worker agent, given an [environment settings object](#) *outside settings* and a boolean *isShared*, return the result of [obtaining a worker/worklet agent](#) given *outside settings*, *isShared*, and true.

To obtain a worklet agent, given an [environment settings object](#) *outside settings*, return the result of [obtaining a worker/worklet agent](#) given *outside settings*, false, and false.

To obtain a service worker agent, return the result of [obtaining a worker/worklet agent](#) given null, true, and false.

---

The following pairs of global objects are each within the same [agent cluster](#), and thus can use [SharedArrayBuffer](#) instances to share memory with each other:

- A [Window](#) object and a dedicated worker that it created.
- A worker (of any type) and a dedicated worker it created.
- A [Window](#) object *A* and the [Window](#) object of an [iframe](#) element that *A* created that could be [same origin-domain](#) with *A*.
- A [Window](#) object and a [same origin-domain Window](#) object that opened it.
- A [Window](#) object and a worklet that it created.

The following pairs of global objects are *not* within the same [agent cluster](#), and thus cannot share memory:

- A [Window](#) object and a shared worker it created.
- A worker (of any type) and a shared worker it created.

- A [Window](#) object and a service worker it created.
- A [Window](#) object and the [Window](#) object of an [iframe](#) element that A created that cannot be [same origin-domain](#) with A.
- Any two [Window](#) objects whose [browsing contexts](#) do not have a non-null [opener](#) or [ancestor](#) relationship. This holds even if the two [Window](#) objects are [same origin](#).

### 8.1.3 Realms and their counterparts

The JavaScript specification introduces the [realm](#) concept, representing a global environment in which script is run. Each realm comes with an [implementation-defined global object](#); much of this specification is devoted to defining that global object and its properties.

For web specifications, it is often useful to associate values or algorithms with a realm/global object pair. When the values are specific to a particular type of realm, they are associated directly with the global object in question, e.g., in the definition of the [Window](#) or [WorkerGlobalScope](#) interfaces. When the values have utility across multiple realms, we use the [environment settings object](#) concept.

Finally, in some cases it is necessary to track associated values before a realm/global object/environment settings object even comes into existence (for example, during [navigation](#)). These values are tracked in the [environment](#) concept.

#### 8.1.3.1 Environments

An *environment* is an object that identifies the settings of a current or potential execution environment. An [environment](#) has the following fields:

##### An *id*

An opaque string that uniquely identifies this [environment](#).

##### A *creation URL*

A [URL](#) that represents the location of the resource with which this [environment](#) is associated.

In the case of an [environment settings object](#), this URL might be distinct from the [environment settings object](#)'s [responsible document](#)'s [URL](#), due to mechanisms such as [history.pushState\(\)](#).

##### A *top-level creation URL*

Null or a [URL](#) that represents the [creation URL](#) of the "top-level" [environment](#). It is null for workers and worklets.

### A *top-level origin*

A for now [implementation-defined](#) value, null, or an [origin](#). For a "top-level" potential execution environment it is null (i.e., when there is no response yet); otherwise it is the "top-level" [environment's origin](#). For a dedicated worker or worklet it is the [top-level origin](#) of its creator. For a shared or service worker it is an [implementation-defined](#) value.

This is distinct from the [top-level creation URL's origin](#) when sandboxing, workers, and worklets are involved.

### A *target browsing context*

Null or a target [browsing context](#) for a [navigation request](#).

### An *active service worker*

Null or a [service worker](#) that [controls](#) the [environment](#).

### An *execution ready flag*

A flag that indicates whether the environment setup is done. It is initially unset.

Specifications may define *environment discarding steps* for environments. The steps take an [environment](#) as input.

The [environment discarding steps](#) are run for only a select few environments: the ones that will never become execution ready because, for example, they failed to load.

#### 8.1.3.2 Environment settings objects

An *environment settings object* is an [environment](#) that additionally specifies algorithms for:

### A *realm execution context*

A [JavaScript execution context](#) shared by all [scripts](#) that use this settings object, i.e. all scripts in a given [JavaScript realm](#). When we [run a classic script](#) or [run a module script](#), this execution context becomes the top of the [JavaScript execution context stack](#), on top of which another execution context specific to the script in question is pushed. (This setup ensures [ParseScript](#) and [Source Text Module Record's Evaluate](#) know which Realm to use.)

### A *module map*

A [module map](#) that is used when importing JavaScript modules.

### A *responsible document*

A [Document](#) that is assigned responsibility for actions taken by the scripts that use this [environment settings object](#).

For example, the [URL](#) of the [responsible document](#) is used to set the [URL](#) of the [Document](#) after it has been reset using [document.open\(\)](#).

If the [responsible event loop](#) is not a [window event loop](#), then the [environment settings object](#) has no [responsible document](#).

#### An *API URL character encoding*

A character encoding used to encode URLs by APIs called by scripts that use this [environment settings object](#).

#### An *API base URL*

A [URL](#) used by APIs called by scripts that use this [environment settings object](#) to parse [URLs](#).

#### An *origin*

An [origin](#) used in security checks.

#### A *policy container*

A [policy container](#) containing policies used for security checks.

#### A *cross-origin isolated capability*

A boolean representing whether scripts that use this [environment settings object](#) are allowed to use APIs that require cross-origin isolation.

An [environment settings object](#) also has an *outstanding rejected promises weak set* and an *about-to-be-notified rejected promises list*, used to track [unhandled promise rejections](#). The [outstanding rejected promises weak set](#) must not create strong references to any of its members, and implementations are free to limit its size, e.g. by removing old entries from it when new ones are added.

An [environment settings object](#)'s *responsible event loop* is its [global object](#)'s [relevant agent](#)'s [event loop](#).

#### 8.1.3.3 Realms, settings objects, and global objects

A *global object* is a JavaScript object that is the `[[GlobalObject]]` field of a [JavaScript realm](#).

In this specification, all [JavaScript realms](#) are [created](#) with [global objects](#) that are either [Window](#) or [WorkerGlobalScope](#) objects.

There is always a 1-to-1-to-1 mapping between [JavaScript realms](#), [global objects](#), and [environment settings objects](#):

- A [JavaScript realm](#) has a `[[HostDefined]]` field, which contains *the Realm's settings object*.
- A [JavaScript realm](#) has a `[[GlobalObject]]` field, which contains *the Realm's global object*.
- Each [global object](#) in this specification is created during the [creation](#) of a corresponding [JavaScript realm](#), known as *the global object's Realm*.
- Each [global object](#) in this specification is created alongside a corresponding [environment settings object](#), known as its [relevant settings object](#).
- An [environment settings object](#)'s [realm execution context](#)'s Realm component is *the environment settings object's Realm*.
- An [environment settings object](#)'s [Realm](#) then has a `[[GlobalObject]]` field, which contains *the environment settings object's global object*.

To *create a new JavaScript realm* in an [agent](#) agent, optionally with instructions to create a global object or a global `this` binding (or both), the following steps are taken:

1. Perform [InitializeHostDefinedRealm\(\)](#) with the provided customizations for creating the global object and the global `this` binding.
2. Let *realm execution context* be the [running JavaScript execution context](#).  
This is the [JavaScript execution context](#) created in the previous step.
3. Remove *realm execution context* from the [JavaScript execution context stack](#).
4. Let *realm* be *realm execution context*'s Realm component.
5. Set *realm*'s agent to *agent*. This pointer is not yet defined in the JavaScript specification; see [tc39/ecma262#1357](#).
6. If *agent*'s [agent cluster](#)'s [cross-origin isolation mode](#) is "[none](#)", then:
  1. Let *global* be *realm*'s [global object](#).
  2. Let *status* be `! global.[[Delete]]("SharedArrayBuffer")`.
  3. Assert: *status* is true.

This is done for compatibility with web content and there is some hope that this can be removed in the future. Web developers can still get at the constructor through `new WebAssembly.Memory({ shared:true, initial:0, maximum:0 }).buffer.constructor`.

---

7. Return *realm execution context*.

---

When defining algorithm steps throughout this specification, it is often important to indicate what [JavaScript realm](#) is to be used—or, equivalently, what [global object](#) or [environment settings object](#) is to be used. In general, there are at least four possibilities:

*Entry*

This corresponds to the script that initiated the currently running script action: i.e., the function or script that the user agent called into when it called into author code.

*Incumbent*

This corresponds to the most-recently-entered author function or script on the stack, or the author function or script that originally scheduled the currently-running callback.

*Current*

This corresponds to the currently-running function object, including built-in user-agent functions which might not be implemented as JavaScript. (It is derived from the [current JavaScript realm](#).)

*Relevant*

Every [platform object](#) has a [relevant Realm](#), which is roughly the [JavaScript realm](#) in which it was created. When writing algorithms, the most prominent [platform object](#) whose [relevant Realm](#) might be important is the `this` value of the currently-running function object. In some cases, there can be other important [relevant Realms](#), such as those of any arguments.

Note how the [entry](#), [incumbent](#), and [current](#) concepts are usable without qualification, whereas the [relevant](#) concept must be applied to a particular [platform object](#).

The [incumbent](#) and [entry](#) concepts should not be used by new specifications, as they are excessively complicated and unintuitive to work with. We are working to remove almost all existing uses from the platform: see [issue #1430](#) for [incumbent](#), and [issue #1431](#) for [entry](#).

In general, web platform specifications should use the [relevant](#) concept, applied to the object being operated on (usually the `this` value of the current method). This mismatches the JavaScript specification, where [current](#) is generally used as the default (e.g. in determining the [JavaScript realm](#) whose [Array](#) constructor should be used to construct the result in [Array.prototype.map](#)). But this inconsistency is so embedded in the platform that we have to accept it going forward.

Consider the following pages, with `a.html` being loaded in a browser window, `b.html` being loaded in an [iframe](#) as shown, and `c.html` and `d.html` omitted (they can simply be empty documents):

```
<!-- a.html -->
<!DOCTYPE html>
<html lang="en">
```

```

<title>Entry page</title>

<iframe src="b.html"></iframe>
<button onclick="frames[0].hello()">Hello</button>

<!--b.html -->
<!DOCTYPE html>
<html lang="en">
<title>Incumbent page</title>

<iframe src="c.html" id="c"></iframe>
<iframe src="d.html" id="d"></iframe>

<script>
 const c = document.querySelector("#c").contentWindow;
 const d = document.querySelector("#d").contentWindow;

 window.hello = () => {
 c.print.call(d);
 };
</script>

```

Each page has its own [browsing context](#), and thus its own [JavaScript realm](#), [global object](#), and [environment settings object](#).

When the [print\(\)](#) method is called in response to pressing the button in [a.html](#), then:

- The [entry Realm](#) is that of [a.html](#).
- The [incumbent Realm](#) is that of [b.html](#).
- The [current Realm](#) is that of [c.html](#) (since it is the [print\(\)](#) method from [c.html](#) whose code is running).
- The [relevant Realm](#) of the object on which the [print\(\)](#) method is being called is that of [d.html](#).

One reason why the [relevant](#) concept is generally a better default choice than the [current](#) concept is that it is more suitable for creating an object that is to be persisted and returned multiple times. For example, the [navigator.getBattery\(\)](#) method creates promises in the [relevant Realm](#) for the [Navigator](#) object on which it is invoked. This has the following impact: [\[BATTERY\]](#)

```

<!-- outer.html -->
<!DOCTYPE html>
<html lang="en">
<title>Relevant Realm demo: outer page</title>

```

```

<script>
 function doTest() {
 const promise = navigator.getBattery.call(frames[0].navigator);

 console.log(promise instanceof Promise); // logs false
 console.log(promise instanceof frames[0].Promise); // logs true

 frames[0].hello();
 }
</script>
<iframe src="inner.html" onload="doTest()"></iframe>

<!-- inner.html -->
<!DOCTYPE html>
<html lang="en">
<title>Relevant Realm demo: inner page</title>
<script>
 function hello() {
 const promise = navigator.getBattery();

 console.log(promise instanceof Promise); // logs true
 console.log(promise instanceof parent.Promise); // logs false
 }
</script>

```

If the algorithm for the [getBattery\(\)](#) method had instead used the [current Realm](#), all the results would be reversed. That is, after the first call to [getBattery\(\)](#) in [outer.html](#), the [Navigator](#) object in [inner.html](#) would be permanently storing a [Promise](#) object created in [outer.html](#)'s [JavaScript realm](#), and calls like that inside the [hello\(\)](#) function would thus return a promise from the "wrong" realm. Since this is undesirable, the algorithm instead uses the [relevant Realm](#), giving the sensible results indicated in the comments above.

---

The rest of this section deals with formally defining the [entry](#), [incumbent](#), [current](#), and [relevant](#) concepts.

#### 8.1.3.3.1 Entry

The process of [calling scripts](#) will push or pop [realm execution contexts](#) onto the [JavaScript execution context stack](#), interspersed with other [execution contexts](#).

With this in hand, we define the *entry execution context* to be the most recently pushed item in the [JavaScript execution context stack](#) that is a [realm execution context](#). The *entry Realm* is the [entry execution context](#)'s Realm component.

Then, the *entry settings object* is the [environment settings object](#) of the [entry Realm](#).

Similarly, the *entry global object* is the [global object](#) of the [entry Realm](#).

#### 8.1.3.3.2 Incumbent

All [JavaScript execution contexts](#) must contain, as part of their code evaluation state, a *skip-when-determining-incumbent counter* value, which is initially zero. In the process of [preparing to run a callback](#) and [cleaning up after running a callback](#), this value will be incremented and decremented.

Every [event loop](#) has an associated *backup incumbent settings object stack*, initially empty. Roughly speaking, it is used to determine the [incumbent settings object](#) when no author code is on the stack, but author code is responsible for the current algorithm having been run in some way. The process of [preparing to run a callback](#) and [cleaning up after running a callback](#) manipulate this stack. [\[WEBIDL\]](#)

When Web IDL is used to [invoke](#) author code, or when [HostEnqueuePromiseJob](#) invokes a promise job, they use the following algorithms to track relevant data for determining the [incumbent settings object](#):

To *prepare to run a callback* with an [environment settings object](#) *settings*:

1. Push *settings* onto the [backup incumbent settings object stack](#).
2. Let *context* be the [topmost script-having execution context](#).
3. If *context* is not null, increment *context*'s [skip-when-determining-incumbent counter](#).

To *clean up after running a callback* with an [environment settings object](#) *settings*:

1. Let *context* be the [topmost script-having execution context](#).  
This will be the same as the [topmost script-having execution context](#) inside the corresponding invocation of [prepare to run a callback](#).
2. If *context* is not null, decrement *context*'s [skip-when-determining-incumbent counter](#).
3. Assert: the topmost entry of the [backup incumbent settings object stack](#) is *settings*.
4. Remove *settings* from the [backup incumbent settings object stack](#).

Here, the *topmost script-having execution context* is the topmost entry of the [JavaScript execution context stack](#) that has a non-null ScriptOrModule component, or null if there is no such entry in the [JavaScript execution context stack](#).

With all this in place, the *incumbent settings object* is determined as follows:

1. Let *context* be the [topmost script-having execution context](#).

2. If *context* is null, or if *context*'s [skip-when-determining-incumbent counter](#) is greater than zero, then:

1. Assert: the [backup incumbent settings object stack](#) is not empty.

This assert would fail if you try to obtain the [incumbent settings object](#) from inside an algorithm that was triggered neither by [calling scripts](#) nor by Web IDL [invoking](#) a callback. For example, it would trigger if you tried to obtain the [incumbent settings object](#) inside an algorithm that ran periodically as part of the [event loop](#), with no involvement of author code. In such cases the [incumbent](#) concept cannot be used.

2. Return the topmost entry of the [backup incumbent settings object stack](#).
3. Return *context*'s Realm component's [settings object](#).

Then, the *incumbent Realm* is the [Realm](#) of the [incumbent settings object](#).

Similarly, the *incumbent global object* is the [global object](#) of the [incumbent settings object](#).

---

The following series of examples is intended to make it clear how all of the different mechanisms contribute to the definition of the [incumbent](#) concept:

Consider the following starter example:

```
<!DOCTYPE html>
<iframe></iframe>
<script>
 frames[0].postMessage("some data", "*");
</script>
```

There are two interesting [environment settings objects](#) here: that of [window](#), and that of [frames\[0\]](#). Our concern is: what is the [incumbent settings object](#) at the time that the algorithm for [postMessage\(\)](#) executes?

It should be that of [window](#), to capture the intuitive notion that the author script responsible for causing the algorithm to happen is executing in [window](#), not [frames\[0\]](#). This makes sense: the [window post message steps](#) use the [incumbent settings object](#) to determine the [source](#) property of the resulting [MessageEvent](#), and in this case [window](#) is definitely the source of the message.

Let us now explain how the steps given above give us our intuitively-desired result of [window](#)'s [relevant settings object](#).

When the [window post message steps](#) look up the [incumbent settings object](#), the [topmost script-having execution context](#) will be that corresponding to the [script](#) element: it was pushed onto

the [JavaScript execution context stack](#) as part of [ScriptEvaluation](#) during the [run a classic script](#) algorithm. Since there are no Web IDL callback invocations involved, the context's [skip-when-determining-incumbent counter](#) is zero, so it is used to determine the [incumbent settings object](#); the result is the [environment settings object](#) of [window](#).

(Note how the [environment settings object](#) of [frames\[0\]](#) is the [relevant settings object](#) of [this](#) at the time the [postMessage\(\)](#) method is called, and thus is involved in determining the [target](#) of the message. Whereas the incumbent is used to determine the [source](#).)

Consider the following more complicated example:

```
<!DOCTYPE html>
<iframe></iframe>
<script>
 const bound = frames[0].postMessage.bind(frames[0], "some data", "*");
 window.setTimeout(bound);
</script>
```

This example is very similar to the previous one, but with an extra indirection through [Function.prototype.bind](#) as well as [setTimeout\(\)](#). But, the answer should be the same: invoking algorithms asynchronously should not change the [incumbent](#) concept.

This time, the result involves more complicated mechanisms:

When **bound** is [converted](#) to a Web IDL callback type, the [incumbent settings object](#) is that corresponding to [window](#) (in the same manner as in our starter example above). Web IDL stores this as the resulting callback value's [callback context](#).

When the [task](#) posted by [setTimeout\(\)](#) executes, the algorithm for that task uses Web IDL to [invoke](#) the stored callback value. Web IDL in turn calls the above [prepare to run a callback](#) algorithm. This pushes the stored [callback context](#) onto the [backup incumbent settings object stack](#). At this time (inside the timer task) there is no author code on the stack, so the [topmost script-having execution context](#) is null, and nothing gets its [skip-when-determining-incumbent counter](#) incremented.

Invoking the callback then calls **bound**, which in turn calls the [postMessage\(\)](#) method of [frames\[0\]](#). When the [postMessage\(\)](#) algorithm looks up the [incumbent settings object](#), there is still no author code on the stack, since the bound function just directly calls the built-in method. So the [topmost script-having execution context](#) will be null: the [JavaScript execution context](#) stack only contains an execution context corresponding to [postMessage\(\)](#), with no [ScriptEvaluation](#) context or similar below it.

This is where we fall back to the [backup incumbent settings object stack](#). As noted above, it will contain as its topmost entry the [relevant settings object](#) of [window](#). So that is what is used as the [incumbent settings object](#) while executing the [postMessage\(\)](#) algorithm.

Consider this final, even more convoluted example:

```

<!-- a.html -->
<!DOCTYPE html>
<button>click me</button>
<iframe></iframe>
<script>
const bound = frames[0].location.assign.bind(frames[0].location, "https://example.com");
document.querySelector("button").addEventListener("click", bound);
</script>

<!-- b.html -->
<!DOCTYPE html>
<iframe src="a.html"></iframe>
<script>
 const iframe = document.querySelector("iframe");
 iframe.onload = function onLoad() {
 iframe.contentWindow.document.querySelector("button").click();
 };
</script>

```

Again there are two interesting [environment settings objects](#) in play: that of `a.html`, and that of `b.html`. When the [location.assign\(\)](#) method triggers the [Location-object navigate](#) algorithm, what will be the [incumbent settings object](#)? As before, it should intuitively be that of `a.html`: the [click](#) listener was originally scheduled by `a.html`, so even if something involving `b.html` causes the listener to fire, the [incumbent](#) responsible is that of `a.html`.

The callback setup is similar to the previous example: when `bound` is [converted](#) to a Web IDL callback type, the [incumbent settings object](#) is that corresponding to `a.html`, which is stored as the callback's [callback context](#).

When the [click\(\)](#) method is called inside `b.html`, it [dispatches](#) a [click](#) event on the button that is inside `a.html`. This time, when the [prepare to run a callback](#) algorithm executes as part of event dispatch, there *is* author code on the stack; the [topmost script-having execution context](#) is that of the `onLoad` function, whose [skip-when-determining-incumbent counter](#) gets incremented. Additionally, `a.html`'s [environment settings object](#) (stored as the [EventHandler](#)'s [callback context](#)) is pushed onto the [backup incumbent settings object stack](#).

Now, when the [Location-object navigate](#) algorithm looks up the [incumbent settings object](#), the [topmost script-having execution context](#) is still that of the `onLoad` function (due to the fact we are using a bound function as the callback). Its [skip-when-determining-incumbent counter](#) value is one, however, so we fall back to the [backup incumbent settings object stack](#). This gives us the [environment settings object](#) of `a.html`, as expected.

Note that this means that even though it is the [iframe](#) inside `a.html` that navigates, it is `a.html` itself that is used as the [source browsing context](#), which determines among other things the [request client](#). This is [perhaps the only justifiable use of the incumbent concept on the web platform](#); in all other cases the consequences of using it are simply confusing and we hope to one day switch them to use [current](#) or [relevant](#) as appropriate.

#### 8.1.3.3.3 Current

The JavaScript specification defines the [current Realm Record](#), sometimes abbreviated to the "current Realm". [\[JAVASCRIPT\]](#)

Then, the *current settings object* is the [environment settings object](#) of the [current Realm Record](#).

Similarly, the *current global object* is the [global object](#) of the [current Realm Record](#).

#### 8.1.3.3.4 Relevant

The *relevant Realm* for a [platform object](#) is the value of [its \[\[Realm\]\] field](#).

Then, the *relevant settings object* for a [platform object](#)  $o$  is the [environment settings object](#) of the [relevant Realm](#) for  $o$ .

Similarly, the *relevant global object* for a [platform object](#)  $o$  is the [global object](#) of the [relevant Realm](#) for  $o$ .

#### 8.1.3.4 Enabling and disabling scripting

*Scripting is enabled* for an [environment settings object](#)  $settings$  when all of the following conditions are true:

- The user agent supports scripting.  
[\(This  
is a  
tracking  
vector.\)](#)
- The user has not disabled scripting for  $settings$  at this time. (User agents may provide users with the option to disable scripting globally, or in a finer-grained manner, e.g., on a per-origin basis, down to the level of individual [environment settings objects](#).)
- Either  $settings$ 's [global object](#) is not a [Window](#) object, or  $settings$ 's [global object](#)'s [associated Document](#)'s [active sandboxing flag set](#) does not have its [sandboxed scripts browsing context flag](#) set.

*Scripting is disabled* for an [environment settings object](#) when scripting is not [enabled](#) for it, i.e., when any of the above conditions are false.

---

*Scripting is enabled* for a node  $node$  if  $node$ 's [node document](#)'s [browsing context](#) is non-null, and [scripting is enabled](#) for  $node$ 's [relevant settings object](#).

*Scripting is disabled* for a node when scripting is not [enabled](#), i.e., when its [node document](#)'s [browsing context](#) is null or when [scripting is disabled](#) for its [relevant settings object](#).

#### 8.1.3.5 Secure contexts

An [environment](#) *environment* is a *secure context* if the following algorithm returns true:

1. If *environment* is an [environment settings object](#), then:
  1. Let *global* be *environment*'s [global object](#).
  2. If *global* is a [WorkerGlobalScope](#), then:
    1. If *global*'s [owner set](#)[0]'s [relevant settings object](#) is a [secure context](#), then return true.
  - We only need to check the 0th item since they will necessarily all be consistent.
  2. Return false.
3. If *global* is a [WorkletGlobalScope](#), then return true.

Worklets can only be created in secure contexts.

2. If the result of [Is url potentially trustworthy?](#) given *environment*'s [top-level creation URL](#) is "Potentially Trustworthy", then return true.
3. Return false.

An [environment](#) is a *non-secure context* if it is not a [secure context](#).

#### 8.1.4 Script processing model

##### 8.1.4.1 Scripts

A *script* is one of three possible [structs](#). All scripts have:

##### A *settings object*

An [environment settings object](#), containing various settings that are shared with other [scripts](#) in the same context.

##### A *record*

One of the following:

- a [script record](#), for [classic scripts](#);
- a [Source Text Module Record](#), for [JavaScript module scripts](#);

- a [Synthetic Module Record](#), for [CSS module scripts](#) and [JSON module scripts](#)
- null, representing a parsing failure.

### A *parse error*

A JavaScript value, which has meaning only if the [record](#) is null, indicating that the corresponding script source text could not be parsed.

This value is used for internal tracking of immediate parse errors when [creating scripts](#), and is not to be used directly. Instead, consult the [error to rethrow](#) when determining "what went wrong" for this script.

### An *error to rethrow*

A JavaScript value representing an error that will prevent evaluation from succeeding. It will be re-thrown by any attempts to [run](#) the script.

This could be the script's [parse error](#), but in the case of a [module script](#) it could instead be the [parse error](#) from one of its dependencies, or an error from [resolve a module specifier](#).

Since this exception value is provided by the JavaScript specification, we know that it is never null, so we use null to signal that no error has occurred.

### *Fetch options*

A [script fetch options](#), containing various options related to fetching this script or [module scripts](#) that it imports.

### A *base URL*

A base [URL](#) used for [resolving module specifiers](#). This will either be the URL from which the script was obtained, for external scripts, or the [document base URL](#) of the containing document, for inline scripts.

A *classic script* is a type of [script](#) that has the following additional [item](#):

### A *muted errors* boolean

A boolean which, if true, means that error information will not be provided for errors in this script. This is used to mute errors for cross-origin scripts, since that can leak private information.

A *module script* is another type of [script](#). It has no additional [items](#).

[Module scripts](#) can be classified into three types:

- A [module script](#) is a *JavaScript module script* if its [record](#) is a [Source Text Module Record](#).

- A [module script](#) is a *CSS module script* if its [record](#) is a [Synthetic Module Record](#), and it was created via the [create a CSS module script](#) algorithm. CSS module scripts represent a parsed CSS stylesheet.
- A [module script](#) is a *JSON module script* if its [record](#) is a [Synthetic Module Record](#), and it was created via the [create a JSON module script](#) algorithm. JSON module scripts represent a parsed JSON document.

As CSS stylesheets and JSON documents do not import dependent modules, and do not throw exceptions on evaluation, the [fetch options](#) and [base URL](#) of [CSS module scripts](#) and [JSON module scripts](#) and are always null.

The *active script* is determined by the following algorithm:

1. Let *record* be [GetActiveScriptOrModule\(\)](#).
2. If *record* is null, return null.
3. Return *record*.[[HostDefined]].

The [active script](#) concept is so far only used by the [import\(\)](#) feature, to determine the [base URL](#) to use for resolving relative module specifiers.

#### 8.1.4.2 Fetching scripts

This section introduces a number of algorithms for fetching scripts, taking various necessary inputs and resulting in [classic](#) or [module scripts](#).

---

*Script fetch options* is a [struct](#) with the following [items](#):

*cryptographic nonce*

The [cryptographic nonce metadata](#) used for the initial fetch and for fetching any imported modules

*integrity metadata*

The [integrity metadata](#) used for the initial fetch

*parser metadata*

The [parser metadata](#) used for the initial fetch and for fetching any imported modules

*credentials mode*

The [credentials mode](#) used for the initial fetch (for [module scripts](#)) and for fetching any imported modules (for both [module scripts](#) and [classic scripts](#))

## *referrer policy*

The [referrer policy](#) used for the initial fetch and for fetching any imported modules

Recall that via the [import\(\)](#) feature, [classic scripts](#) can import [module scripts](#).

The *default classic script fetch options* are a [script fetch options](#) whose [cryptographic nonce](#) is the empty string, [integrity metadata](#) is the empty string, [parser metadata](#) is "not-parser-inserted", [credentials mode](#) is "same-origin", and [referrer policy](#) is the empty string.

Given a [request](#) *request* and a [script fetch options](#) *options*, we define:

### *set up the classic script request*

Set *request*'s [cryptographic nonce metadata](#) to *options*'s [cryptographic nonce](#), its [integrity metadata](#) to *options*'s [integrity metadata](#), its [parser metadata](#) to *options*'s [parser metadata](#), and its [referrer policy](#) to *options*'s [referrer policy](#).

### *set up the module script request*

Set *request*'s [cryptographic nonce metadata](#) to *options*'s [cryptographic nonce](#), its [integrity metadata](#) to *options*'s [integrity metadata](#), its [parser metadata](#) to *options*'s [parser metadata](#), its [credentials mode](#) to *options*'s [credentials mode](#), and its [referrer policy](#) to *options*'s [referrer policy](#).

For any given [script fetch options](#) *options*, the *descendant script fetch options* are a new [script fetch options](#) whose [items](#) all have the same values, except for the [integrity metadata](#), which is instead the empty string.

---

The algorithms below can be customized by optionally supplying a custom [perform the fetch](#) hook, which takes a [request](#) and an [is top-level](#) flag. The algorithm must complete with a [response](#) (which may be a [network error](#)), either synchronously (when using [fetch a classic worker-imported script](#)) or asynchronously (otherwise). The [is top-level](#) flag will be set for all [classic script](#) fetches, and for the initial fetch when [fetching an external module script graph](#), [fetching a module worker script graph](#), or [fetching an import\(\) module script graph](#), but not for the fetches resulting from [import](#) statements encountered throughout the graph.

By default, not supplying the [perform the fetch](#) will cause the below algorithms to simply [fetch](#) the given [request](#), with algorithm-specific customizations to the [request](#) and validations of the resulting [response](#).

To layer your own customizations on top of these algorithm-specific ones, supply a [perform the fetch](#) hook that modifies the given [request](#), [fetches](#) it, and then performs specific validations of the resulting [response](#) (completing with a [network error](#) if the validations fail).

The hook can also be used to perform more subtle customizations, such as keeping a cache of [responses](#) and avoiding performing a [fetch](#) at all.

Service Workers is an example of a specification that runs these algorithms with its own options for the hook. [SW]

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Now for the algorithms themselves.

To *fetch* a *classic script* given a *url*, a *settings object*, some *options*, a *CORS setting*, and a *character encoding*, run these steps. The algorithm will asynchronously complete with either null (on failure) or a new [classic script](#) (on success).

1. Let *request* be the result of [creating a potential-CORS request](#) given *url*, "script", and *CORS setting*.
2. Set *request*'s [client](#) to *settings object*.
3. [Set up the classic script request](#) given *request* and *options*.
4. If the caller specified custom steps to [perform the fetch](#), perform them on *request*, with the [is top-level](#) flag set. Return from this algorithm, and when the custom [perform the fetch](#) steps complete with [response](#), run the remaining steps.

Otherwise, [fetch](#) *request*. Return from this algorithm, and run the remaining steps as part of the *fetch*'s [process response](#) for the [response](#) response.

*response* can be either [CORS-same-origin](#) or [CORS-cross-origin](#). This only affects how error reporting happens.

5. Set *response* to *response*'s [unsafe response](#).
6. If *response*'s [type](#) is "error", or *response*'s [status](#) is not an [ok status](#), then asynchronously complete this algorithm with null, and return.

For historical reasons, this algorithm does not include MIME type checking, unlike the other script-fetching algorithms in this section.

7. If *response*'s [Content Type metadata](#), if any, specifies a character encoding, and the user agent supports that encoding, then set *character encoding* to that encoding (ignoring the passed-in value).
8. Let *source text* be the result of [decoding](#) *response*'s [body](#) to Unicode, using *character encoding* as the fallback encoding.

The [decode](#) algorithm overrides *character encoding* if the file contains a BOM.

9. Let *muted errors* be true if *response* was [CORS-cross-origin](#), and false otherwise.
10. Let *script* be the result of [creating a classic script](#) given *source text*, *settings object*, *response*'s [url](#), *options*, and *muted errors*.

11. Asynchronously complete this algorithm with *script*.

To *fetch a classic worker script* given a *url*, a *fetch client settings object*, a *destination*, and a *script settings object*, run these steps. The algorithm will asynchronously complete with either null (on failure) or a new [classic script](#) (on success).

1. Let *request* be a new [request](#) whose [URL](#) is *url*, [client](#) is *fetch client settings object*, [destination](#) is *destination*, [mode](#) is "same-origin", [credentials mode](#) is "same-origin", [parser metadata](#) is "not parser-inserted", and whose [use-URL-credentials flag](#) is set.
2. If the caller specified custom steps to [perform the fetch](#), perform them on *request*, with the [is top-level](#) flag set. Return from this algorithm, and when the custom [perform the fetch](#) steps complete with [response](#) *response*, run the remaining steps.

Otherwise, [fetch](#) *request*. Return from this algorithm, and run the remaining steps as part of the fetch's [process response](#) for the [response](#) *response*.

3. Set *response* to *response*'s [unsafe response](#).
4. If either of the following conditions are met:
  - *response*'s [type](#) is "error"; or
  - *response*'s [status](#) is not an [ok status](#),

then asynchronously complete this algorithm with null, and return.

5. If both of the following conditions are met:
  - *response*'s [url](#)'s [scheme](#) is an [HTTP\(S\) scheme](#); and
  - the result of [extracting a MIME type](#) from *response*'s [header list](#) is not a [JavaScript MIME type](#),

then asynchronously complete this algorithm with null, and return.

Other [fetch schemes](#) are exempted from MIME type checking for historical web-compatibility reasons. We might be able to tighten this in the future; see [issue #3255](#).

6. Let *source text* be the result of [UTF-8 decoding](#) *response*'s [body](#).
7. Let *script* be the result of [creating a classic script](#) using *source text*, *script settings object*, *response*'s [url](#), and the [default classic script fetch options](#).
8. Asynchronously complete this algorithm with *script*.

To *fetch a classic worker-imported script* given a *url* and a *settings object*, run these steps. The

algorithm will synchronously complete with a [classic script](#) on success, or throw an exception on failure.

1. Let *request* be a new [request](#) whose [URL](#) is *url*, [client](#) is *settings object*, [destination](#) is ["script"](#), [parser metadata](#) is ["not parser-inserted"](#), [synchronous flag](#) is set, and whose [use-URL-credentials flag](#) is set.
2. If the caller specified custom steps to [perform the fetch](#), perform them on *request*, with the [is top-level](#) flag set. Let *response* be the result.

Otherwise, [fetch](#) *request*, and let *response* be the result.

Unlike other algorithms in this section, the fetching process is synchronous here. Thus any [perform the fetch](#) steps will also finish their work synchronously.

3. Set *response* to *response*'s [unsafe response](#).
4. If any of the following conditions are met:
  - *response*'s [type](#) is ["error"](#); or
  - *response*'s [status](#) is not an [ok status](#); or
  - the result of [extracting a MIME type](#) from *response*'s [header list](#) is not a [JavaScript MIME type](#),then throw a ["NetworkError" DOMException](#).
5. Let *source text* be the result of [UTF-8 decoding](#) *response*'s [body](#).
6. Let *muted errors* be true if *response* was [CORS-cross-origin](#), and false otherwise.
7. Let *script* be the result of [creating a classic script](#) given *source text*, *settings object*, *response*'s [url](#), the [default classic script fetch options](#), and *muted errors*.
8. Return *script*.

To *fetch an external module script graph* given a *url*, a *settings object*, and some *options*, run these steps. The algorithm will asynchronously complete with either null (on failure) or a [module script](#) (on success).

1. [Fetch a single module script](#) given *url*, *settings object*, ["script"](#), *options*, *settings object*, ["client"](#), and with the [top-level module fetch flag](#) set. If the caller of this algorithm specified custom [perform the fetch](#) steps, pass those along as well. Wait until the algorithm asynchronously completes with *result*.
2. If *result* is null, asynchronously complete this algorithm with null, and return.

3. Let *visited* set be  $\langle\langle \text{url}, \text{"javascript"} \rangle\rangle$ .
4. [Fetch the descendants of and link](#) *result* given *settings object*, *destination*, and *visited set*. When this asynchronously completes with *final result*, asynchronously complete this algorithm with *final result*.

To *fetch an import() module script graph* given a *moduleRequest*, a *base URL*, a *settings object*, and some *options*, run these steps. The algorithm will asynchronously complete with either null (on failure) or a [module script](#) (on success).

1. Let *url* be the result of [resolving a module specifier](#) given *base URL* and *moduleRequest.[[Specifier]]*.
2. If *url* is failure, then asynchronously complete this algorithm with null, and return.
3. Assert: *moduleRequest.[[Assertions]]* does not contain any [Record](#) entry such that *entry.[[Key]]* is not "type", because we only asked for "type" assertions in [HostGetSupportedImportAssertions](#).
4. Let *moduleType* be the result of running the [module type from module request](#) steps given *moduleRequest*.
5. If the result of running the [module type allowed](#) steps given *moduleType* and *settings object* is false, then asynchronously complete this algorithm with null, and return.
6. [Fetch a single module script](#) given *url*, *settings object*, "script", *options*, *settings object*, "client", *moduleRequest*, and with the top-level *module fetch flag* set. If the caller of this algorithm specified custom [perform the fetch](#) steps, pass those along as well. Wait until the algorithm asynchronously completes with *result*.
7. If *result* is null, asynchronously complete this algorithm with null, and return.
8. Let *visited* set be  $\langle\langle \text{url}, \text{moduleType} \rangle\rangle$ .
9. [Fetch the descendants of and link](#) *result* given *settings object*, *destination*, and *visited set*. When this asynchronously completes with *final result*, asynchronously complete this algorithm with *final result*.

To *fetch a modulepreload module script graph* given a *url*, a *destination*, a *settings object*, and some *options*, run these steps. The algorithm will asynchronously complete with either null (on failure) or a [module script](#) (on success), although it will perform optional steps even after completing.

1. [Fetch a single module script](#) given *url*, *settings object*, *destination*, *options*, *settings object*, "client", and with the top-level *module fetch flag* set. Wait until algorithm asynchronously completes with *result*.
2. Asynchronously complete this algorithm with *result*, but do not return.

3. If *result* is not null, optionally perform the following steps:

1. Let *visited* set be `«(url, "javascript")».`
2. [Fetch the descendants of and link](#) *result* given *settings object*, *destination*, and *visited* set.

Generally, performing these steps will be beneficial for performance, as it allows pre-loading the modules that will invariably be requested later, via algorithms such as [fetch an external module script graph](#) that fetch the entire graph. However, user agents might wish to skip them in bandwidth-constrained situations, or situations where the relevant fetches are already in flight.

To *fetch an inline module script graph* given a *source text*, *base URL*, *settings object*, and *options*, run these steps. The algorithm will asynchronously complete with either null (on failure) or a [module script](#) (on success).

1. Let *script* be the result of [creating a JavaScript module script](#) using *source text*, *settings object*, *base URL*, and *options*.
2. If *script* is null, asynchronously complete this algorithm with null, and return.
3. Let *visited* set be an empty [set](#).
4. [Fetch the descendants of and link](#) *script*, given *settings object*, the destination `"script"`, and *visited* set. When this asynchronously completes with *final result*, asynchronously complete this algorithm with *final result*.

To *fetch a module worker script graph* given a *url*, a *fetch client settings object*, a *destination*, a *credentials mode*, and a *module map settings object*, [fetch a worklet/module worker script graph](#) given *url*, *fetch client settings object*, *destination*, *credentials mode*, and *module map settings object*, asynchronously completing with the asynchronous completion result of that algorithm.

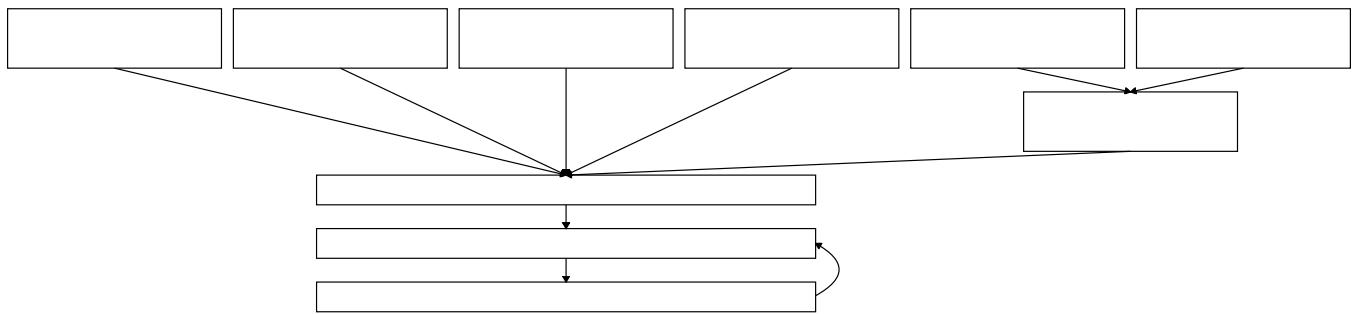
To *fetch a worklet script graph* given a *url*, a *fetch client settings object*, a *destination*, a *credentials mode*, a *module map settings object*, and a *module responses map*, [fetch a worklet/module worker script graph](#) given *url*, *fetch client settings object*, *destination*, *credentials mode*, and *module map settings object*, asynchronously completing with the asynchronous completion result of that algorithm. Use the following custom steps to [perform the fetch](#) given *response*:

1. Let *requestURL* be *request*'s [URL](#).
2. If *moduleResponsesMap[requestURL]* is `"fetching"`, wait [in parallel](#) until that entry's value changes, then [queue a task](#) on the [networking task source](#) to proceed with running the following steps.
3. If *moduleResponsesMap[requestURL]* [exists](#), then asynchronously complete the [perform the fetch](#) steps with *moduleResponsesMap[requestURL]*.

4. Set `moduleResponsesMap[requestURL]` to "fetching".
  5. Fetch `request`. To process response for the `response` response:
    1. Set `moduleResponsesMap[requestURL]` to `response`.
    2. Asynchronously complete the `perform the fetch` steps with `response`.
- 

The following algorithms are meant for internal use by this specification only as part of [fetching an external module script graph](#) or other similar concepts above, and should not be used directly by other specifications.

This diagram illustrates how these algorithms relate to the ones above, as well as to each other:



To fetch a worklet/module worker script graph given a `url`, a `fetch client settings object`, a `destination`, a `credentials mode`, and a `module map settings object`, run these steps. The algorithm will asynchronously complete with either null (on failure) or a [module script](#) (on success).

1. Let `options` be a [script fetch options](#) whose [cryptographic nonce](#) is the empty string, [integrity metadata](#) is the empty string, [parser metadata](#) is "not-parser-inserted", [credentials mode](#) is `credentials mode`, and [referrer policy](#) is the empty string.
2. Fetch a single module script given `url`, `fetch client settings object`, `destination`, `options`, `module map settings object`, "client", and with the top-level module fetch flag set. If the caller of this algorithm specified custom [perform the fetch](#) steps, pass those along as well. Wait until the algorithm asynchronously completes with `result`.
3. If `result` is null, asynchronously complete this algorithm with null, and return.
4. Let `visited set` be `«(url, "javascript")»`.
5. Fetch the descendants of and link `result` given `fetch client settings object`, `destination`, and `visited set`. When this asynchronously completes with `final result`, asynchronously complete this algorithm with `final result`.

To fetch the descendants of and link a module script `module script`, given a `fetch client settings`

*object*, a *destination*, and a *visited set*, run these steps. The algorithm will asynchronously complete with either null (on failure) or with *module script* (on success).

1. [Fetch the descendants of module script](#), given *fetch client settings object*, *destination*, and *visited set*.
2. Return from this algorithm, and run the following steps when [fetching the descendants of a module script](#) asynchronously completes with *result*.
3. If *result* is null, then asynchronously complete this algorithm with *result*.

In this case, there was an error fetching one or more of the descendants. We will not attempt to link.

4. Let *parse error* be the result of [finding the first parse error](#) given *result*.

5. If *parse error* is null, then:

1. Let *record* be *result*'s [record](#).
2. Perform *record*.[Link\(\)](#).

This step will recursively call [Link](#) on all of the module's unlinked dependencies.

If this throws an exception, set *result*'s [error to rethrow](#) to that exception.

6. Otherwise, set *result*'s [error to rethrow](#) to *parse error*.
7. Asynchronously complete this algorithm with *result*.

To [fetch the descendants of a module script](#) *module script*, given a *fetch client settings object*, a *destination*, and a *visited set*, run these steps. The algorithm will asynchronously complete with either null (on failure) or with *module script* (on success).

1. If *module script*'s [record](#) is null, then asynchronously complete this algorithm with *module script* and return.
2. Let *record* be *module script*'s [record](#).
3. If *record* is not a [Cyclic Module Record](#), or if *record*.[[RequestedModules]] [is empty](#), asynchronously complete this algorithm with *module script*.
4. Let *moduleRequests* be a new empty [list](#).
5. [For each ModuleRequest Record requested](#) of *record*.[[RequestedModules]],
  1. Let *url* be the result of [resolving a module specifier](#) given *module script*'s [base URL](#) and *requested*.[[Specifier]].

2. Assert: *url* is never failure, because [resolving a module specifier](#) must have been [previously successful](#) with these same two arguments.
3. Let *moduleType* be the result of running the [module type from module request](#) steps given *requested*.
4. If *visited set* does not [contain](#) (*url*, *moduleType*), then:
  1. [Append](#) *requested* to *moduleRequests*.
  2. [Append](#) (*url*, *moduleType*) to *visited set*.
6. Let *options* be the [descendant script fetch options](#) for *module script*'s [fetch options](#).
7. Assert: *options* is not null, as *module script* is a [JavaScript module script](#).
8. [For each](#) *moduleRequest* in *moduleRequests*, perform the [internal module script graph fetching procedure](#) given *moduleRequest*, *fetch client settings object*, *destination*, *options*, *module script*'s [settings object](#), *visited set*, and *module script*'s [base URL](#). If the caller of this algorithm specified custom [perform the fetch](#) steps, pass those along while performing the [internal module script graph fetching procedure](#).

These invocations of the [internal module script graph fetching procedure](#) should be performed in parallel to each other.

If any of the invocations of the [internal module script graph fetching procedure](#) asynchronously complete with null, asynchronously complete this algorithm with null, and return.

Otherwise, wait until all of the [internal module script graph fetching procedure](#) invocations have asynchronously completed. Asynchronously complete this algorithm with *module script*.

To perform the *internal module script graph fetching procedure* given a *moduleRequest*, a *fetch client settings object*, a *destination*, some *options*, a *module map settings object*, a *visited set*, and a *referrer*, perform these steps. The algorithm will asynchronously complete with either null (on failure) or a [module script](#) (on success).

1. Let *url* be the result of [resolving a module specifier](#) given *referrer* and *moduleRequest*.[\[\[Specifier\]\]](#).
2. Assert: *url* is never failure, because [resolving a module specifier](#) must have been [previously successful](#) with these same two arguments.
3. Let *moduleType* be the result of running the [module type from module request](#) steps given *moduleRequest*.
4. Assert: *visited set* [contains](#) (*url*, *moduleType*).

5. [Fetch a single module script](#) given *url*, *fetch client settings object*, *destination*, *options*, *module map settings object*, *referrer*, *moduleRequest*, and with the *top-level module fetch flag* unset. If the caller of this algorithm specified custom [perform the fetch](#) steps, pass those along while [fetching a single module script](#).
6. Return from this algorithm, and run the following steps when [fetching a single module script](#) asynchronously completes with *result*:
7. If *result* is null, asynchronously complete this algorithm with null, and return.
8. [Fetch the descendants of](#) *result* given *fetch client settings object*, *destination*, and *visited set*.
9. When the appropriate algorithm asynchronously completes with *final result*, asynchronously complete this algorithm with *final result*.

To *fetch a single module script*, given a *url*, a *fetch client settings object*, a *destination*, some *options*, a *module map settings object*, a *referrer*, an optional *moduleRequest*, and a *top-level module fetch flag*, run these steps. The algorithm will asynchronously complete with either null (on failure) or a [module script](#) (on success).

1. Let *moduleType* be "javascript".
2. If *moduleRequest* was given, then set *moduleType* to the result of running the [module type from module request](#) steps given *moduleRequest*.
3. Assert: the result of running the [module type allowed](#) steps given *moduleType* and *module map settings object* is true. Otherwise we would not have reached this point because a failure would have been raised when inspecting *moduleRequest*.[[Assertions]] in [create a JavaScript module script](#) or [fetch an import\(\) module script graph](#).
4. Let *moduleMap* be *module map settings object*'s [module map](#).
5. If *moduleMap*[(*url*, *moduleType*)] is "fetching", wait [in parallel](#) until that entry's value changes, then [queue a task](#) on the [networking task source](#) to proceed with running the following steps.
6. If *moduleMap*[(*url*, *moduleType*)] [exists](#), asynchronously complete this algorithm with *moduleMap*[*url* / *moduleType*], and return.
7. [Set](#) *moduleMap*[(*url*, *moduleType*)] to "fetching".
8. Let *request* be a new [request](#) whose [URL](#) is *url*, [destination](#) is *destination*, [mode](#) is "cors", [referrer](#) is *referrer*, and [client](#) is *fetch client settings object*.
9. If *destination* is "worker", "sharedworker", or "serviceworker", and the *top-level module fetch flag* is set, then set *request*'s [mode](#) to "same-origin".

10. Set up the module script request given *request* and *options*.
11. If the caller specified custom steps to [perform the fetch](#), perform them on *request*, setting the *is top-level* flag if the *top-level module fetch* flag is set. Return from this algorithm, and when the custom [perform the fetch](#) steps complete with [response response](#), run the remaining steps.

Otherwise, [fetch](#) *request*. Return from this algorithm, and run the remaining steps as part of the fetch's [process response](#) for the [response response](#).

*response* is always [CORS-same-origin](#).

12. If either of the following conditions are met:

- *response*'s [type](#) is "error"; or
- *response*'s [status](#) is not an [ok status](#).

then [set](#) *moduleMap*[(*url*, *moduleType*)] to null, asynchronously complete this algorithm with null, and return.

13. Let *source text* be the result of [UTF-8 decoding](#) *response*'s [body](#).
14. Let *MIME type* be the result of [extracting a MIME type](#) from *response*'s [header list](#).
15. Let *module script* be null.
16. If *MIME type* is a [JavaScript MIME type](#) and *moduleType* is "javascript", then set *module script* to the result of [creating a JavaScript module script](#) given *source text*, *module map settings object*, *response*'s [url](#), and *options*.
17. If the [MIME type essence](#) of *MIME type* is "text/css" and *moduleType* is "css", then set *module script* to the result of [creating a CSS module script](#) given *source text* and *module map settings object*.
18. If *MIME type essence* is a [JSON MIME type](#) and *moduleType* is "json", then set *module script* to the result of [creating a JSON module script](#) given *source text* and *module map settings object*.
19. [Set](#) *moduleMap*[(*url*, *moduleType*)] to *module script*, and asynchronously complete this algorithm with *module script*.

It is intentional that the [module map](#) is keyed by the [request URL](#), whereas the [base URL](#) for the [module script](#) is set to the [response URL](#). The former is used to deduplicate fetches, while the latter is used for URL resolution.

To find the first parse error given a root *moduleScript* and an optional *discoveredSet*:

1. Let *moduleMap* be *moduleScript*'s [settings object](#)'s [module map](#).
2. If *discoveredSet* was not given, let it be an empty [set](#).
3. [Append](#) *moduleScript* to *discoveredSet*.
4. If *moduleScript*'s [record](#) is null, then return *moduleScript*'s [parse error](#).
5. If *moduleScript*'s [record](#) is not a [Cyclic Module Record](#), then return null.
6. Let *moduleRequests* be the value of *moduleScript*'s [record](#)'s [\[\[RequestedModules\]\]](#) internal slot.
7. [For each](#) *moduleRequest* of *moduleRequests*:
  1. Let *childURL* be the result of [resolving a module specifier](#) given *moduleScript*'s [base URL](#) and *moduleRequest*.[\[\[Specifier\]\]](#). (This will never fail, as otherwise *moduleScript* would have been [marked as itself having a parse error](#).)
  2. Let *moduleType* be the result of running the [module type from module request](#) steps given *moduleRequest*.
  3. Let *childModule* be *moduleMap*[*childURL*, *moduleType*].
  4. Assert: *childModule* is a [module script](#) (i.e., it is not **"fetching"** or null); by now all [module scripts](#) in the graph rooted at *moduleScript* will have successfully been fetched.
  5. If *discoveredSet* already [contains](#) *childModule*, [continue](#).
  6. Let *childParseError* be the result of [finding the first parse error](#) given *childModule* and *discoveredSet*.
  7. If *childParseError* is not null, return *childParseError*.
8. Return null.

#### 8.1.4.3 Creating scripts

To create a *classic script*, given a [string](#) *source*, an [environment settings object](#) *settings*, a [URL](#) *baseURL*, some [script fetch options](#) *options*, and an optional *muted errors* boolean:

1. If *muted errors* was not provided, let it be false.
2. If *muted errors* is true, then set *baseURL* to [about:blank](#).

When *muted errors* is true, *baseURL* is the script's [CORS-cross-origin response](#)'s [url](#), which shouldn't be exposed to JavaScript. Therefore, *baseURL* is sanitized here.

3. If [scripting is disabled](#) for *settings*, then set *source* to the empty string.
4. Let *script* be a new [classic script](#) that this algorithm will subsequently initialize.
5. Set *script*'s [settings object](#) to *settings*.
6. Set *script*'s [base URL](#) to *baseURL*.
7. Set *script*'s [fetch options](#) to *options*.
8. Set *script*'s [muted errors](#) to *muted errors*.
9. Set *script*'s [parse error](#) and [error to rethrow](#) to null.
10. Let *result* be [ParseScript](#)(*source*, *settings*'s [Realm](#), *script*).

Passing *script* as the last parameter here ensures *result*.[[HostDefined]] will be *script*.

11. If *result* is a [list](#) of errors, then:
  1. Set *script*'s [parse error](#) and its [error to rethrow](#) to *result*[0].
  2. Return *script*.
12. Set *script*'s [record](#) to *result*.
13. Return *script*.

To create a JavaScript module script, given a [string](#) *source*, an [environment settings object](#) *settings*, a [URL](#) *baseURL*, and some [script fetch options](#) *options*:

1. If [scripting is disabled](#) for *settings*, then set *source* to the empty string.
2. Let *script* be a new [module script](#) that this algorithm will subsequently initialize.
3. Set *script*'s [settings object](#) to *settings*.
4. Set *script*'s [base URL](#) to *baseURL*.
5. Set *script*'s [fetch options](#) to *options*.
6. Set *script*'s [parse error](#) and [error to rethrow](#) to null.
7. Let *result* be [ParseModule](#)(*source*, *settings*'s [Realm](#), *script*).

Passing *script* as the last parameter here ensures *result*.[[HostDefined]] will be *script*.

8. If *result* is a [list](#) of errors, then:

1. Set *script*'s [parse error](#) to *result*[0].
  2. Return *script*.
9. Assert: *requested*.[[Assertions]] does not contain any [Record](#) entry such that *entry*.[[Key]] is not "type", because we only asked for "type" assertions in [HostGetSupportedImportAssertions](#).
10. For each [ModuleRequest record](#) *requested* of *result*.[[RequestedModules]]:
1. Let *url* be the result of [resolving a module specifier](#) given *script*'s [base URL](#) and *requested*.[[Specifier]].
  2. Let *moduleType* be the result of running the [module type from module request](#) steps given *requested*.
  3. If *url* is failure, or if the result of running the [module type allowed](#) steps given *moduleType* and *settings* is false, then:
    1. Let *error* be a new [TypeError](#) exception.
    2. Set *script*'s [parse error](#) to *error*.
    3. Return *script*.

This step is essentially validating all of the requested module specifiers and type assertions. We treat a module with unresolvable module specifiers or unsupported type assertions the same as one that cannot be parsed; in both cases, a syntactic issue makes it impossible to ever contemplate linking the module later.

11. Set *script*'s [record](#) to *result*.
12. Return *script*.

To create a CSS module script, given a string *source* and an [environment settings object](#) *settings*:

1. Let *script* be a new [module script](#) that this algorithm will subsequently initialize.
2. Set *script*'s [settings object](#) to *settings*.
3. Set *script*'s [base URL](#) and [fetch options](#) to null.
4. Set *script*'s [parse error](#) and [error to rethrow](#) to null.
5. Let *sheet* be the result of running the steps to [create a constructed CSSStyleSheet](#) with an empty dictionary as the argument.

6. Run the steps to [synchronously replace the rules of a `CSSStyleSheet`](#) on `sheet` given `source`.

If this throws an exception, set `script`'s [parse error](#) to that exception, and return `script`.

The steps to [synchronously replace the rules of a `CSSStyleSheet`](#) will throw if `source` contains any `@import` rules. This is by-design for now because there is not yet an agreement on how to handle these for CSS module scripts; therefore they are blocked altogether until a consensus is reached.

7. Set `script`'s [record](#) to the result of [CreateDefaultExportSyntheticModule](#)(`sheet`).

8. Return `script`.

To *create a JSON module script*, given a string `source` and an [environment settings object](#) `settings`:

1. Let `script` be a new [module script](#) that this algorithm will subsequently initialize.
2. Set `script`'s [settings object](#) to `settings`.
3. Set `script`'s [base URL](#) and [fetch options](#) to null.
4. Set `script`'s [parse error](#) and [error to rethrow](#) to null.
5. Let `result` be [ParseJSONModule](#)(`source`).

If this throws an exception, set `script`'s [parse error](#) to that exception, and return `script`.

6. Set `script`'s [record](#) to `result`.
7. Return `script`.

The *module type from module request* steps, given a [ModuleRequest Record](#) `moduleRequest`, are as follows:

1. Let `moduleType` be "javascript".
2. If `moduleRequest.[[Assertions]]` has a [Record](#) entry such that `entry.[[Key]]` is "type", then:
  1. If `entry.[[Value]]` is "javascript", then set `moduleType` to null.

This specification uses the "javascript" module type internally for [JavaScript module scripts](#), so this step is needed to prevent modules from being imported using a "javascript" type assertion (a null `moduleType` will cause the [module type allowed](#) check to fail).

2. Otherwise, set *moduleType* to *entry*.[[Value]].
3. Return *moduleType*.

The *module type allowed* steps, given a [string](#) *moduleType* and an [environment settings object](#) *settings*, are as follows:

1. If *moduleType* is not "javascript", "css", or "json", then return false.
2. If *moduleType* is "css" and the [CSSStyleSheet](#) interface is not [exposed](#) in *settings*'s [Realm](#), then return false.
3. Return true.

#### 8.1.4.4 Calling scripts

To *run a classic script* given a [classic script](#) *script* and an optional boolean *rethrow errors* (default false):

1. Let *settings* be the [settings object](#) of *script*.
2. [Check if we can run script](#) with *settings*. If this returns "do not run" then return [NormalCompletion](#)(empty).
3. [Prepare to run script](#) given *settings*.
4. Let *evaluationStatus* be null.
5. If *script*'s [error to rethrow](#) is not null, then set *evaluationStatus* to Completion { [[Type]]: throw, [[Value]]: *script*'s [error to rethrow](#), [[Target]]: empty }.
6. Otherwise, set *evaluationStatus* to [ScriptEvaluation](#)(*script*'s [record](#)).

If [ScriptEvaluation](#) does not complete because the user agent has [aborted the running script](#), leave *evaluationStatus* as null.

7. If *evaluationStatus* is an [abrupt completion](#), then:
  1. If *rethrow errors* is true and *script*'s [muted errors](#) is false, then:
    1. [Clean up after running script](#) with *settings*.
    2. Rethrow *evaluationStatus*.[[Value]].
  2. If *rethrow errors* is true and *script*'s [muted errors](#) is true, then:
    1. [Clean up after running script](#) with *settings*.

2. Throw a "[NetworkError](#)" [DOMException](#).
3. Otherwise, *rethrow errors* is false. Perform the following steps:
  1. [Report the exception](#) given by *evaluationStatus*.[[Value]] for *script*.
  2. [Clean up after running script](#) with *settings*.
  3. Return *evaluationStatus*.
8. [Clean up after running script](#) with *settings*.
9. If *evaluationStatus* is a normal completion, then return *evaluationStatus*.
10. If we've reached this point, *evaluationStatus* was left as null because the script was [aborted prematurely](#) during evaluation. Return Completion { [[Type]]: throw, [[Value]]: a new "[QuotaExceededError](#)" [DOMException](#), [[Target]]: empty }.

To run a *module script* given a [module script](#) *script* and an optional boolean *preventErrorReporting* (default false):

1. Let *settings* be the [settings object](#) of *script*.
2. [Check if we can run script](#) with *settings*. If this returns "do not run", then return a promise resolved with undefined.
3. [Prepare to run script](#) given *settings*.
4. Let *evaluationPromise* be null.
5. If *script*'s [error to rethrow](#) is not null, then set *evaluationPromise* to [a promise rejected with](#) *script*'s [error to rethrow](#).
6. Otherwise:
  1. Let *record* be *script*'s [record](#).
  2. Set *evaluationPromise* to *record*.[Evaluate\(\)](#).

This step will recursively evaluate all of the module's dependencies.

If [Evaluate](#) fails to complete as a result of the user agent [aborting the running script](#), then set *evaluationPromise* to [a promise rejected with](#) a new "[QuotaExceededError](#)" [DOMException](#).

7. If *preventErrorReporting* is false, then [upon rejection](#) of *evaluationPromise* with *reason*, [report the exception](#) given by *reason* for *script*.

8. [Clean up after running script](#) with *settings*.

9. Return *evaluationPromise*.

The steps to *check if we can run script* with an [environment settings object](#) *settings* are as follows. They return either "run" or "do not run".

1. If the [global object](#) specified by *settings* is a [Window](#) object whose [Document](#) object is not [fully active](#), then return "do not run".
2. If [scripting is disabled](#) for *settings*, then return "do not run".
3. Return "run".

The steps to *prepare to run script* with an [environment settings object](#) *settings* are as follows:

1. Push *settings*'s [realm execution context](#) onto the [JavaScript execution context stack](#); it is now the [running JavaScript execution context](#).
2. Add *settings* to the currently running [task](#)'s [script evaluation environment settings object set](#).

The steps to *clean up after running script* with an [environment settings object](#) *settings* are as follows:

1. Assert: *settings*'s [realm execution context](#) is the [running JavaScript execution context](#).
2. Remove *settings*'s [realm execution context](#) from the [JavaScript execution context stack](#).
3. If the [JavaScript execution context stack](#) is now empty, [perform a microtask checkpoint](#). (If this runs scripts, these algorithms will be invoked reentrantly.)

These algorithms are not invoked by one script directly calling another, but they can be invoked reentrantly in an indirect manner, e.g. if a script dispatches an event which has event listeners registered.

The *running script* is the [script](#) in the [\[\[HostDefined\]\]](#) field in the [ScriptOrModule](#) component of the [running JavaScript execution context](#).

#### 8.1.4.5 Killing scripts

Although the JavaScript specification does not account for this possibility, it's sometimes necessary to *abort a running script*. This causes any [ScriptEvaluation](#) or [Source Text Module Record Evaluate](#) invocations to cease immediately, emptying the [JavaScript execution context stack](#) without triggering any of the normal mechanisms like [finally](#) blocks. [\[JAVASCRIPT\]](#)

User agents may impose resource limitations on scripts, for example CPU quotas, memory limits, total execution time limits, or bandwidth limitations. When a script exceeds a limit, the

user agent may either throw a "[QuotaExceededError](#)" [DOMException](#), [abort the script](#) without an exception, prompt the user, or throttle script execution.

For example, the following script never terminates. A user agent could, after waiting for a few seconds, prompt the user to either terminate the script or let it continue.

```
<script>
 while (true) { /* loop */ }
</script>
```

User agents are encouraged to allow users to disable scripting whenever the user is prompted either by a script (e.g. using the [window.alert\(\)](#) API) or because of a script's actions (e.g. because it has exceeded a time limit).

If scripting is disabled while a script is executing, the script should be terminated immediately.

User agents may allow users to specifically disable scripts just for the purposes of closing a [browsing context](#).

For example, the prompt mentioned in the example above could also offer the user with a mechanism to just close the page entirely, without running any [unload](#) event handlers.

#### 8.1.4.6 Runtime script errors

##### **self.reportError(e)**

Dispatches an [error](#) event at the global object for the given value *e*, in the same fashion as an unhandled exception.

When the user agent is required to *report an error* for a particular [script](#) *script* with a particular position *line:col*, using a particular target *target*, it must run these steps, after which the error is either *handled* or *not handled*:

1. If *target* is [in error reporting mode](#), then return; the error is [not handled](#).
2. Let *target* be [in error reporting mode](#).
3. [\(This  
is a  
tracking  
vector.\)](#) Let *message* be an [implementation-defined](#) string describing the error in a helpful manner.
4. Let *errorValue* be the value that represents the error: in the case of an uncaught exception, that would be the value that was thrown; in the case of a JavaScript error that would be an [Error](#) object. If there is no corresponding value, then the null value must be used instead.

- Let *urlString* be the result of applying the [URL serializer](#) to the [URL record](#) that corresponds to the resource from which *script* was obtained.

The resource containing the script will typically be the file from which the [Document](#) was parsed, e.g. for inline [script](#) elements or [event handler content attributes](#); or the JavaScript file that the script was in, for external scripts. Even for dynamically-generated scripts, user agents are strongly encouraged to attempt to keep track of the original source of a script. For example, if an external script uses the [document.write\(\)](#) API to insert an inline [script](#) element during parsing, the URL of the resource containing the script would ideally be reported as being the external script, and the line number might ideally be reported as the line with the [document.write\(\)](#) call or where the string passed to that call was first constructed. Naturally, implementing this can be somewhat non-trivial.

User agents are similarly encouraged to keep careful track of the original line numbers, even in the face of [document.write\(\)](#) calls mutating the document as it is parsed, or [event handler content attributes](#) spanning multiple lines.

- If *script*'s [muted errors](#) is true, then set *message* to "Script error.", *urlString* to the empty string, *line* and *col* to 0, and *errorValue* to null.
- Let *notHandled* be true.
- If *target* implements [EventTarget](#), then set *notHandled* to the result of [firing an event](#) named [error](#) at *target*, using [ErrorEvent](#), with the [cancelable](#) attribute initialized to true, the [message](#) attribute initialized to *message*, the [filename](#) attribute initialized to *urlString*, the [lineno](#) attribute initialized to *line*, the [colno](#) attribute initialized to *col*, and the [error](#) attribute initialized to *errorValue*.
- Let *target* no longer be [in error reporting mode](#).
- If *notHandled* is false, then the error is [handled](#). Otherwise, the error is [not handled](#).

Returning true in an event handler cancels the event per [the event handler processing algorithm](#).

When the user agent is to *report an exception E*, the user agent must [report the error](#) for the relevant [script](#), with the problematic position (line number and column number) in the resource containing the script, using the [global object](#) specified by the script's [settings object](#) as the target. If the error is still [not handled](#) after this, then the error may be reported to a developer console.

The existence of both [report an error](#) and [report an exception](#) is confusing, and both algorithms have known problems. You can track future cleanup in this area in [issue #958](#).

The [reportError\(e\)](#) method steps are to [report the exception](#) *e*.

## [ErrorEvent](#)

Support in all current engines.

---

Firefox30+Safari6+Chrome10+

---

Opera11+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android30+Safari iOS6+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

The [ErrorEvent](#) interface is defined as follows:

```
[Exposed=(Window,Worker)]
interface ErrorEvent : Event {
 constructor(DOMString type, optional ErrorEventInit eventInitDict = {});

 readonly attribute DOMString message;
 readonly attribute USVString filename;
 readonly attribute unsigned long lineno;
 readonly attribute unsigned long colno;
 readonly attribute any error;
};

dictionary ErrorEventInit : EventInit {
 DOMString message = "";
 USVString filename = "";
 unsigned long lineno = 0;
 unsigned long colno = 0;
 any error = null;
};
```

The **message** attribute must return the value it was initialized to. It represents the error message.

The **filename** attribute must return the value it was initialized to. It represents the [URL](#) of the script in which the error originally occurred.

The **lineno** attribute must return the value it was initialized to. It represents the line number where the error occurred in the script.

The **colno** attribute must return the value it was initialized to. It represents the column number where the error occurred in the script.

The **error** attribute must return the value it was initialized to. Where appropriate, it is set to the object representing the error (e.g., the exception object in the case of an uncaught DOM

exception).

#### 8.1.4.7 Unhandled promise rejections



##### [Window/rejectionhandled\\_event](#)

Support in all current engines.

Firefox 69+ | Safari 11+ | Chrome 49+

---

Opera 36+ | Edge 79+

Edge (Legacy) | No | Internet Explorer | No

---

Firefox | Android 6.0 | Safari | iOS 11.3+ | Chrome | Android 49+ | WebView | Android 49+ | Samsung Internet 5.0+ | Opera | Android 36+

In addition to synchronous [runtime script errors](#), scripts may experience asynchronous promise rejections, tracked via the [unhandledrejection](#) and [rejectionhandled](#) events. Tracking these rejections is done via the [HostPromiseRejectionTracker](#) abstract operation, but reporting them is defined here.

To *notify about rejected promises* on a given [environment settings object](#) *settings object*:

1. Let *list* be a copy of *settings object*'s [about-to-be-notified rejected promises list](#).
2. If *list* is empty, return.
3. Clear *settings object*'s [about-to-be-notified rejected promises list](#).
4. Let *global* be *settings object*'s [global object](#).
5. [Queue a global task](#) on the [DOM manipulation task source](#) given *global* to run the following substep:
  1. For each promise *p* in *list*:
    1. If *p*'s `[[PromiseIsHandled]]` internal slot is true, continue to the next iteration of the loop.
    2. Let *notHandled* be the result of [firing an event](#) named [unhandledrejection](#) at *global*, using [PromiseRejectionEvent](#), with the [cancelable](#) attribute initialized to true, the [promise](#) attribute initialized to *p*, and the [reason](#) attribute initialized to the value of *p*'s `[[PromiseResult]]` internal slot.
    3. If *notHandled* is false, then the promise rejection is [handled](#). Otherwise, the promise rejection is [not handled](#).

4. If  $p$ 's `[[PromiseIsHandled]]` internal slot is false, add  $p$  to *settings object's outstanding rejected promises weak set*.

This algorithm results in promise rejections being marked as *handled* or *not handled*. These concepts parallel *handled* and *not handled* script errors. If a rejection is still *not handled* after this, then the rejection may be reported to a developer console.



## [PromiseRejectionEvent](#)

Support in all current engines.

Firefox 69+ Safari 11+ Chrome 49+

---

Opera 36+ Edge 79+

Edge (Legacy) No Internet Explorer No

---

Firefox Android 68+ Safari iOS 11.3+ Chrome Android 49+ WebView Android 49+ Samsung Internet 5.0+ Opera Android 36+

The [PromiseRejectionEvent](#) interface is defined as follows:

```
[Exposed=(Window,Worker)]
interface PromiseRejectionEvent : Event {
 constructor(DOMString type, PromiseRejectionEventInit eventInitDict);

 readonly attribute Promise<any> promise;
 readonly attribute any reason;
};

dictionary PromiseRejectionEventInit : EventInit {
 required Promise<any> promise;
 any reason;
};
```



## [PromiseRejectionEvent/promise](#)

Support in all current engines.

Firefox 69+ Safari 11+ Chrome 49+

---

Opera 36+ Edge 79+

Edge (Legacy) No Internet Explorer No

---

Firefox Android 68+ Safari iOS 11.3+ Chrome Android 49+ WebView Android 49+ Samsung Internet 5.0+ Opera Android 36+

The ***promise*** attribute must return the value it was initialized to. It represents the promise which this notification is about.



## [PromiseRejectionEvent/reason](#)

Support in all current engines.

Firefox 69+ Safari 11+ Chrome 49+

---

Opera 36+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 68+ Safari iOS 11.3+ Chrome Android 49+ WebView Android 49+ Samsung Internet 5.0+ Opera Android 36+

The ***reason*** attribute must return the value it was initialized to. It represents the rejection reason for the promise.

### 8.1.5 JavaScript specification host hooks

The JavaScript specification contains a number of [implementation-defined](#) abstract operations, that vary depending on the host environment. This section defines them for user agent hosts.

#### 8.1.5.1 *HostEnsureCanCompileStrings(callerRealm, calleeRealm)*

JavaScript contains an [implementation-defined](#) `HostEnsureCanCompileStrings(callerRealm, calleeRealm)` abstract operation. User agents must use the following implementation:

[\[JAVASCRIPT\]](#)

1. Perform ? [EnsureCSPDoesNotBlockStringCompilation\(callerRealm, calleeRealm\)](#). [\[CSP\]](#)

#### 8.1.5.2 *HostPromiseRejectionTracker(promise, operation)*

JavaScript contains an [implementation-defined](#) `HostPromiseRejectionTracker(promise, operation)` abstract operation. User agents must use the following implementation:

[\[JAVASCRIPT\]](#)

1. Let *script* be the [running script](#).
2. If *script*'s [muted errors](#) is true, terminate these steps.
3. Let *settings object* be *script*'s [settings object](#).
4. If *operation* is "reject",
  1. Add *promise* to *settings object*'s [about-to-be-notified rejected promises list](#).

5. If *operation* is "handle",
  1. If *settings object*'s [about-to-be-notified rejected promises list](#) contains *promise*, then remove *promise* from that list and return.
  2. If *settings object*'s [outstanding rejected promises weak set](#) does not contain *promise*, then return.
  3. Remove *promise* from *settings object*'s [outstanding rejected promises weak set](#).
  4. Let *global* be *settings object*'s [global object](#).
  5. [Queue a global task](#) on the [DOM manipulation task source](#) given *global* to [fire an event](#) named [rejectionhandled](#) at *global*, using [PromiseRejectionEvent](#), with the [promise](#) attribute initialized to *promise*, and the [reason](#) attribute initialized to the value of *promise*'s [[PromiseResult]] internal slot.

#### 8.1.5.3 Job-related host hooks

MDN

[Reference/Global\\_Objects/Promise#Incumbent\\_settings\\_object\\_tracking](#)

Support in one engine only.

Firefox50+SafariNoChromeNo

---

OperaNoEdgeNo

---

Edge (Legacy)NoInternet ExplorerNo

---

Firefox Android50+Safari iOSNoChrome AndroidNoWebView AndroidNoSamsung

InternetNoOpera AndroidNo

The JavaScript specification defines Jobs to be scheduled and run later by the host, as well as [JobCallback Records](#) which encapsulate JavaScript functions that are called as part of jobs. The JavaScript specification contains a number of [implementation-defined](#) abstract operations that lets the host define how jobs are scheduled and how JobCallbacks are handled. HTML uses these abstract operations to track the [incumbent settings object](#) in promises and [FinalizationRegistry](#) callbacks by saving and restoring the [incumbent settings object](#) and a [JavaScript execution context](#) for the [active script](#) in JobCallbacks. This section defines them for user agent hosts.

##### 8.1.5.3.1 HostCallJobCallback(*callback*, *V*, *argumentsList*)

JavaScript contains an [implementation-defined](#) [HostCallJobCallback](#)(*callback*, *V*, *argumentsList*) abstract operation to let hosts restore state when invoking JavaScript callbacks from inside tasks. User agents must use the following implementation: [\[JAVASCRIPT\]](#)

1. Let *incumbent settings* be *callback*.[[HostDefined]].[[IncumbentSettings]].
2. Let *script execution context* be *callback*.[[HostDefined]].[[ActiveScriptContext]].
3. [Prepare to run a callback](#) with *incumbent settings*.  
This affects the [incumbent](#) concept while the callback runs.
4. If *script execution context* is not null, then [push](#) *script execution context* onto the [JavaScript execution context stack](#).  
This affects the [active script](#) while the callback runs.
5. Let *result* be [Call](#)(*callback*.[[Callback]], *V*, *argumentsList*).
6. If *script execution context* is not null, then [pop](#) *script execution context* from the [JavaScript execution context stack](#).
7. [Clean up after running a callback](#) with *incumbent settings*.
8. Return *result*.

#### 8.1.5.3.2 HostEnqueueFinalizationRegistryCleanupJob(*finalizationRegistry*)

JavaScript has the ability to register objects with [FinalizationRegistry](#) objects, in order to schedule a cleanup action if they are found to be garbage collected. The JavaScript specification contains an [implementation-defined](#) [HostEnqueueFinalizationRegistryCleanupJob](#)(*finalizationRegistry*) abstract operation to schedule the cleanup action.

The timing and occurrence of cleanup work is [implementation-defined](#) in the JavaScript specification. User agents might differ in when and whether an object is garbage collected, affecting both whether the return value of the [WeakRef.prototype.deref\(\)](#) method is undefined, and whether [FinalizationRegistry](#) cleanup callbacks occur. There are well-known cases in popular web browsers where objects are not accessible to JavaScript, but they remain retained by the garbage collector indefinitely. HTML clears kept-alive [WeakRef](#) objects in the [perform a microtask checkpoint](#) algorithm. Authors would be best off not depending on the timing details of garbage collection implementations.

Cleanup actions do not take place interspersed with synchronous JavaScript execution, but rather happen in queued [tasks](#). User agents must use the following implementation:  
[\[JAVASCRIPT\]](#)

1. Let *global* be *finalizationRegistry*.[[Realm]]'s [global object](#).
2. [Queue a global task](#) on the *JavaScript engine task source* given *global* to perform the following steps:

1. Let *entry* be *finalizationRegistry*.[[CleanupCallback]].[[Callback]].[[Realm]]'s [environment settings object](#).
2. [Check if we can run script](#) with *entry*. If this returns "do not run", then return.
3. [Prepare to run script](#) with *entry*.

This affects the [entry](#) concept while the cleanup callback runs.

4. Let *result* be the result of performing [CleanupFinalizationRegistry](#)(*finalizationRegistry*).
5. [Clean up after running script](#) with *entry*.
6. If *result* is an [abrupt completion](#), then [report the exception](#) given by *result*.[[Value]].

#### 8.1.5.3.3 *HostEnqueuePromiseJob(job, realm)*

JavaScript contains an [implementation-defined HostEnqueuePromiseJob](#)(*job, realm*) abstract operation to schedule Promise-related operations. HTML schedules these operations in the microtask queue. User agents must use the following implementation: [\[JAVASCRIPT\]](#)

1. If *realm* is not null, then let *job settings* be the [settings object](#) for *realm*. Otherwise, let *job settings* be null.

If *realm* is not null, it is the [Realm](#) of the author code that will run. When *job* is returned by [NewPromiseReactionJob](#), it is the realm of the promise's handler function. When *job* is returned by [NewPromiseResolveThenableJob](#), it is the realm of the [then](#) function.

If *realm* is null, either no author code will run or author code is guaranteed to throw. For the former, the author may not have passed in code to run, such as in `promise.then(null, null)`. For the latter, it is because a revoked Proxy was passed. In both cases, all the steps below that would otherwise use *job settings* get skipped.

2. [Queue a microtask](#) on the [surrounding agent's event loop](#) to perform the following steps:

1. If *job settings* is not null, then [check if we can run script](#) with *job settings*. If this returns "do not run" then return.
2. If *job settings* is not null, then [prepare to run script](#) with *job settings*.

This affects the [entry](#) concept while the job runs.

3. Let *result* be *job()*.

*job* is an [abstract closure](#) returned by [NewPromiseReactionJob](#) or [NewPromiseResolveThenableJob](#). The promise's handler function when *job* is returned by [NewPromiseReactionJob](#), and the **then** function when *job* is returned by [NewPromiseResolveThenableJob](#), are wrapped in [JobCallback Records](#). HTML saves the [incumbent settings object](#) and a [JavaScript execution context](#) for to the [active script](#) in [HostMakeJobCallback](#) and restores them in [HostCallJobCallback](#).

4. If *job settings* is not null, then [clean up after running script](#) with *job settings*.
5. If *result* is an [abrupt completion](#), then [report the exception](#) given by *result.[[Value]]*.

#### 8.1.5.3.4 *HostMakeJobCallback(callable)*

JavaScript contains an [implementation-defined](#) [HostMakeJobCallback\(callable\)](#) abstract operation to let hosts attach state to JavaScript callbacks that are called from inside [tasks](#). User agents must use the following implementation: [\[JAVASCRIPT\]](#)

1. Let *incumbent settings* be the [incumbent settings object](#).
2. Let *active script* be the [active script](#).
3. Let *script execution context* be null.
4. If *active script* is not null, set *script execution context* to a new [JavaScript execution context](#), with its Function field set to null, its Realm field set to *active script*'s [settings object](#)'s [Realm](#), and its ScriptOrModule set to *active script*'s [record](#).

As seen below, this is used in order to propagate the current [active script](#) forward to the time when the job callback is invoked.

A case where *active script* is non-null, and saving it in this way is useful, is the following:

```
Promise.resolve('import(`./example.mjs`)').then(eval);
```

Without this step (and the steps that use it in [HostCallJobCallback](#)), there would be no [active script](#) when the [import\(\)](#) expression is evaluated, since [eval\(\)](#) is a built-in function that does not originate from any particular [script](#).

With this step in place, the active script is propagated from the above code into the job, allowing [import\(\)](#) to use the original script's [base URL](#) appropriately.

*active script* can be null if the user clicks on the following button:

```
<button onclick="Promise.resolve('import(`./example.mjs`)').then(eval)">
```

In this case, the JavaScript function for the [event handler](#) will be created by the [get the current value of the event handler](#) algorithm, which creates a function with null `[[ScriptOrModule]]` value. Thus, when the promise machinery calls [HostMakeJobCallback](#), there will be no [active script](#) to pass along.

As a consequence, this means that when the [import\(\)](#) expression is evaluated, there will still be no [active script](#). Fortunately that is handled by our implementations of [HostResolveImportedModule](#) and [HostImportModuleDynamically](#), by falling back to using the [current settings object's API base URL](#).

5. Return the [JobCallback Record](#) { `[[Callback]]: callable, [[HostDefined]]: { [[IncumbentSettings]]: incumbent settings, [[ActiveScriptContext]]: script execution context }` }.

#### 8.1.5.4 Module-related host hooks

The JavaScript specification defines a syntax for modules, as well as some host-agnostic parts of their processing model. This specification defines the rest of their processing model: how the module system is bootstrapped, via the [script](#) element with [type](#) attribute set to "module", and how modules are fetched, resolved, and executed. [\[JAVASCRIPT\]](#)

Although the JavaScript specification speaks in terms of "scripts" versus "modules", in general this specification speaks in terms of [classic scripts](#) versus [module scripts](#), since both of them use the [script](#) element.

### **`modulePromise = import(specifier)`**

Returns a promise for the module namespace object for the [module script](#) identified by *specifier*. This allows dynamic importing of module scripts at runtime, instead of statically using the [import](#) statement form. The specifier will be [resolved](#) relative to the [active script's base URL](#).

The returned promise will be rejected if an invalid specifier is given, or if a failure is encountered while [fetching](#) or [evaluating](#) the resulting module graph.

This syntax can be used inside both [classic](#) and [module scripts](#). It thus provides a bridge into the module-script world, from the classic-script world.

### **`url = import.meta.url`**

Returns the [active module script's base URL](#).

This syntax can only be used inside [module scripts](#).

A *module map* is a [map](#) keyed by [tuples](#) consisting of a [URL record](#) and a [string](#). The [URL](#)

[record](#) is the [request URL](#) at which the module was fetched, and the [string](#) indicates the type of the module (e.g. "javascript"). The [module map](#)'s values are either a [module script](#), null (used to represent failed fetches), or a placeholder value "fetching". [Module maps](#) are used to ensure that imported module scripts are only fetched, parsed, and evaluated once per [Document](#) or [worker](#).

Since [module maps](#) are keyed by (URL, module type), the following code will create three separate entries in the [module map](#), since it results in three different (URL, module type) [tuples](#) (all with "javascript" type):

```
import "https://example.com/module.mjs";
import "https://example.com/module.mjs#map-buster";
import "https://example.com/module.mjs?debug=true";
```

That is, URL [queries](#) and [fragments](#) can be varied to create distinct entries in the [module map](#); they are not ignored. Thus, three separate fetches and three separate module evaluations will be performed.

In contrast, the following code would only create a single entry in the [module map](#), since after applying the [URL parser](#) to these inputs, the resulting [URL records](#) are equal:

```
import "https://example.com/module2.mjs";
import "https://example.com/module2.mjs";
import "https:////example.com\\module2.mjs";
import "https://example.com/foo/..module2.mjs";
```

So in this second example, only one fetch and one module evaluation will occur.

Note that this behavior is the same as how [shared workers](#) are keyed by their parsed [constructor url](#).

Since module type is also part of the [module map](#) key, the following code will create two separate entries in the [module map](#) (the type is "javascript" for the first, and "css" for the second):

```
<script type=module>
 import "https://example.com/module";
</script>
<script type=module>
 import "https://example.com/module" assert { type: "css" };
</script>
```

This can result in two separate fetches and two separate module evaluations being performed. This is a [willful violation](#) of a constraint recommended (but not required) by the import assertions specification stating that each call to [HostResolveImportedModule](#) with the same (*referencingScriptOrModule*, *moduleRequest.[[Specifier]]*) pair must return the same [Module Record](#). [\[JSIMPORTASSERTIONS\]](#)

In practice, due to the as-yet-unspecified memory cache (see issue [#6110](#)) the resource may only be fetched once in WebKit and Blink-based browsers. Additionally, as long as all module types are mutually exclusive, the module type check in [fetch a single module script](#) will fail for at least one of the imports, so at most one module evaluation will occur.

The purpose of including the type in the [module map](#) key is so that an import with the wrong type assertion does not prevent a different import of the same specifier but with the correct type from succeeding.

JavaScript module scripts are the default import type when importing from another JavaScript module; that is, when an `import` statement lacks a `type` import assertion the imported module script's type will be JavaScript. Attempting to import a JavaScript resource using an `import` statement with a `type` import assertion will fail:

```
<script type="module">
 // All of the following will fail, assuming that the imported .mjs files are
 // JavaScript MIME type. JavaScript module scripts are the default and can
 // any import type assertion.
 import foo from "./foo.mjs" assert { type: "javascript" };
 import foo2 from "./foo2.mjs" assert { type: "js" };
 import foo3 from "./foo3.mjs" assert { type: "" };
 await import("./foo4.mjs", { assert: { type: null } });
 await import("./foo5.mjs", { assert: { type: undefined } });
</script>
```

To resolve a *module specifier* given a [URL](#) *base URL* and a [string](#) *specifier*, perform the following steps. It will return either a [URL record](#) or failure.

1. Apply the [URL parser](#) to *specifier*. If the result is not failure, return the result.
2. If *specifier* does not start with the character U+002F SOLIDUS (/), the two-character sequence U+002E FULL STOP, U+002F SOLIDUS (./), or the three-character sequence U+002E FULL STOP, U+002E FULL STOP, U+002F SOLIDUS (../), return failure.

This restriction is in place so that in the future we can allow custom module loaders to give special meaning to "bare" import specifiers, like `import "jquery"` or `import "web/crypto"`. For now any such imports will fail, instead of being treated as relative URLs.

3. Return the result of applying the [URL parser](#) to *specifier* with *base URL*.

The following are valid module specifiers according to the above algorithm:

- `https://example.com/apples.mjs`
- `http://example.com\pears.js` (becomes `http://example.com/pears.js` as step 1 parses with no base URL)
- `//example.com/bananas`

- `./strawberries.mjs.cgi`
- `../lychees`
- `/limes.jsx`
- `data:text/javascript,export default 'grapes';`
- `blob:https://whatwg.org/d0360e2f-caee-469f-9a2f-87d5b0456f6f`

The following are valid module specifiers according to the above algorithm, but will invariably cause failures when they are [fetched](#):

- `javascript:export default 'artichokes';`
- `data:text/plain,export default 'kale';`
- `about:legumes`
- `wss://example.com/celery`

The following are not valid module specifiers according to the above algorithm:

- `https://eggplant:b/c`
- `pumpkins.js`
- `.tomato`
- `..zucchini.mjs`
- `.\yam.es`

#### 8.1.5.4.1 `HostGetImportMetaProperties(moduleRecord)`



#### [Reference/Statements/import.meta](#)

Support in all current engines.

Firefox 62+ Safari 11.1+ Chrome 64+

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Opera 51+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

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Firefox Android 62+ Safari iOS 12+ Chrome Android 64+ WebView Android 64+ Samsung Internet 9.0+ Opera Android 47+

JavaScript contains an [implementation-defined](#) `HostGetImportMetaProperties` abstract operation. User agents must use the following implementation: [\[JAVASCRIPT\]](#)

1. Let `module script` be `moduleRecord.[[HostDefined]]`.
2. Assert: `module script`'s [base URL](#) is not null, as `module script` is a [JavaScript module script](#).
3. Let `urlString` be `module script`'s [base URL](#), [serialized](#).

4. Return « Record { [[Key]]: "url", [[Value]]: urlString } ».

#### 8.1.5.4.2 HostImportModuleDynamically(*referencingScriptOrModule*, *moduleRequest*, *promiseCapability*)

JavaScript contains an [implementation-defined HostImportModuleDynamically](#) abstract operation. User agents must use the following implementation: [\[JAVASCRIPT\]](#)

1. Let *settings object* be the [current settings object](#).
2. If *settings object*'s [global object](#) implements [WorkletGlobalScope](#) or [ServiceWorkerGlobalScope](#), then:
  1. Let *completion* be Completion { [[Type]]: throw, [[Value]]: a new [TypeError](#), [[Target]]: empty }.
  2. Perform [FinishDynamicImport](#)(*referencingScriptOrModule*, *moduleRequest*, *promiseCapability*, *completion*).
  3. Return.
3. Let *base URL* be *settings object*'s [API base URL](#).
4. Let *fetch options* be the [default classic script fetch options](#).
5. If *referencingScriptOrModule* is not null, then:
  1. Let *referencing script* be *referencingScriptOrModule*.[[HostDefined]].
  2. Set *settings object* to *referencing script*'s [settings object](#).
  3. Set *base URL* to *referencing script*'s [base URL](#).
  4. Set *fetch options* to the [descendant script fetch options](#) for *referencing script*'s [fetch options](#).
  5. Assert: Neither *base URL* nor *fetch options* is null, as *referencing script* is a [classic script](#) or a [JavaScript module script](#).

As explained above for [HostResolveImportedModule](#), in the common case, *referencingScriptOrModule* is non-null.

6. [Fetch an import\(\) module script graph](#) given *moduleRequest*, *base URL*, *settings object*, and *fetch options*. Wait until the algorithm asynchronously completes with *result*.
7. Let *promise* be null.
8. If *result* is null, then set *promise* to [a promise rejected with](#) a new [TypeError](#).

9. Otherwise, set *promise* to the result of [running a module script](#) given *result* and true.
10. Perform [FinishDynamicImport](#)(*referencingScriptOrModule*, *moduleRequest*, *promiseCapability*, *promise*).
11. Return undefined.

#### 8.1.5.4.3 *HostResolveImportedModule*(*referencingScriptOrModule*, *moduleRequest*)

JavaScript contains an [implementation-defined](#) [HostResolveImportedModule](#) abstract operation. User agents must use the following implementation: [\[JAVASCRIPT\]](#)

1. Let *settings object* be the [current settings object](#).
2. Let *base URL* be *settings object*'s [API base URL](#).
3. If *referencingScriptOrModule* is not null, then:
  1. Let *referencing script* be *referencingScriptOrModule*.[[HostDefined]].
  2. Set *settings object* to *referencing script*'s [settings object](#).
  3. Set *base URL* to *referencing script*'s [base URL](#).
4. Assert: *base URL* is not null, as *referencing script* is a [classic script](#) or a [JavaScript module script](#).

*referencingScriptOrModule* is not usually null, but will be so for event handlers per the [get the current value of the event handler](#) algorithm. For example, given:

```
<button onclick="import('./foo.mjs')">Click me</button>
```

If a [click](#) event occurs, then at the time the [import\(\)](#) expression runs, [GetActiveScriptOrModule](#) will return null, which will be passed to this abstract operation when [HostResolveImportedModule](#) is called by [FinishDynamicImport](#).

4. Let *moduleMap* be *settings object*'s [module map](#).
5. Let *url* be the result of [resolving a module specifier](#) given *base URL* and *moduleRequest*.[[Specifier]].
6. Assert: *url* is never failure, because [resolving a module specifier](#) must have been previously successful with these same two arguments (either [while creating the corresponding module script](#), or in [fetch an import\(\) module script graph](#)).
7. Let *moduleType* be the result of running the [module type from module request](#) steps given *moduleRequest*.

8. Let *resolved module script* be  $\text{moduleMap}[(url, \text{moduleType})]$ . (This entry must [exist](#) for us to have gotten to this point.)
9. Assert: *resolved module script* is a [module script](#) (i.e., is not null or "fetching").
10. Assert: *resolved module script*'s [record](#) is not null.
11. Return *resolved module script*'s [record](#).

#### 8.1.5.4.4 `HostGetSupportedImportAssertions()`

The *Import Assertions* proposal contains an [implementation-defined](#) [HostGetSupportedImportAssertions](#) abstract operation. User agents must use the following implementation: [\[JSIMPORTASSERTIONS\]](#)

1. Return « "type" ».

### 8.1.6 Event loops

#### 8.1.6.1 Definitions

To coordinate events, user interaction, scripts, rendering, networking, and so forth, user agents must use *event loops* as described in this section. Each [agent](#) has an associated *event loop*, which is unique to that agent.

The [event loop](#) of a [similar-origin window agent](#) is known as a *window event loop*. The [event loop](#) of a [dedicated worker agent](#), [shared worker agent](#), or [service worker agent](#) is known as a *worker event loop*. And the [event loop](#) of a [worklet agent](#) is known as a *worklet event loop*.

[Event loops](#) do not necessarily correspond to implementation threads. For example, multiple [window event loops](#) could be cooperatively scheduled in a single thread.

However, for the various worker [agents](#) that are allocated with `[[CanBlock]]` set to true, the JavaScript specification does place requirements on them regarding [forward progress](#), which effectively amount to requiring dedicated per-agent threads in those cases.

---

An [event loop](#) has one or more *task queues*. A [task queue](#) is a [set](#) of [tasks](#).

[Task queues](#) are [sets](#), not [queues](#), because [step one of the event loop processing model](#) grabs the first [Runnable task](#) from the chosen queue, instead of [dequeuing](#) the first task.

The [microtask queue](#) is not a [task queue](#).

Tasks encapsulate algorithms that are responsible for such work as:

## Events

Dispatching an [Event](#) object at a particular [EventTarget](#) object is often done by a dedicated task.

Not all events are dispatched using the [task queue](#); many are dispatched during other tasks.

## Parsing

The [HTML parser](#) tokenizing one or more bytes, and then processing any resulting tokens, is typically a task.

## Callbacks

Calling a callback is often done by a dedicated task.

## Using a resource

When an algorithm [fetches](#) a resource, if the fetching occurs in a non-blocking fashion then the processing of the resource once some or all of the resource is available is performed by a task.

## Reacting to DOM manipulation

Some elements have tasks that trigger in response to DOM manipulation, e.g. when that element is [inserted into the document](#).

Formally, a *task* is a [struct](#) which has:

### Steps

A series of steps specifying the work to be done by the task.

### A source

One of the [task sources](#), used to group and serialize related tasks.

### A document

A [Document](#) associated with the task, or null for tasks that are not in a [window event loop](#).

### A script evaluation environment settings object set

A [set](#) of [environment settings objects](#) used for tracking script evaluation during the task.

A [task](#) is *Runnable* if its [document](#) is either null or [fully active](#).

Per its [source](#) field, each [task](#) is defined as coming from a specific *task source*. For each [event loop](#), every [task source](#) must be associated with a specific [task queue](#).

Essentially, [task sources](#) are used within standards to separate logically-different types of tasks, which a user agent might wish to distinguish between. [Task queues](#) are used by user agents to

coalesce task sources within a given [event loop](#).

For example, a user agent could have one [task queue](#) for mouse and key events (to which the [user interaction task source](#) is associated), and another to which all other [task sources](#) are associated. Then, using the freedom granted in the initial step of the [event loop processing model](#), it could give keyboard and mouse events preference over other tasks three-quarters of the time, keeping the interface responsive but not starving other task queues. Note that in this setup, the processing model still enforces that the user agent would never process events from any one [task source](#) out of order.

---

Each [event loop](#) has a *currently running task*, which is either a [task](#) or null. Initially, this is null. It is used to handle reentrancy.

Each [event loop](#) has a *microtask queue*, which is a [queue](#) of [microtasks](#), initially empty. A [microtask](#) is a colloquial way of referring to a [task](#) that was created via the [queue a microtask](#) algorithm.

Each [event loop](#) has a *performing a microtask checkpoint* boolean, which is initially false. It is used to prevent reentrant invocation of the [perform a microtask checkpoint](#) algorithm.

Each [window event loop](#) has a [DOMHighResTimeStamp](#) *last render opportunity time*, initially set to zero.

Each [window event loop](#) has a [DOMHighResTimeStamp](#) *last idle period start time*, initially set to zero.

To get the *same-loop windows* for a [window event loop](#) *loop*, return all [Window](#) objects whose [relevant agent's event loop](#) is *loop*.

#### 8.1.6.2 Queuing tasks

To *queue a task* on a [task source](#) *source*, which performs a series of steps *steps*, optionally given an event loop *event loop* and a document *document*:

1. If *event loop* was not given, set *event loop* to the [implied event loop](#).
2. If *document* was not given, set *document* to the [implied document](#).
3. Let *task* be a new [task](#).
4. Set *task*'s [steps](#) to *steps*.
5. Set *task*'s [source](#) to *source*.
6. Set *task*'s [document](#) to the *document*.
7. Set *task*'s [script evaluation environment settings object set](#) to an empty [set](#).

8. Let *queue* be the [task queue](#) to which *source* is associated on *event loop*.
9. [Append](#) *task* to *queue*.

Failing to pass an event loop and document to [queue a task](#) means relying on the ambiguous and poorly-specified [implied event loop](#) and [implied document](#) concepts. Specification authors should either always pass these values, or use the wrapper algorithms [queue a global task](#) or [queue an element task](#) instead. Using the wrapper algorithms is recommended.

To *queue a global task* on a [task source](#) source, with a [global object](#) *global* and a series of steps *steps*:

1. Let *event loop* be *global*'s [relevant agent](#)'s [event loop](#).
2. Let *document* be *global*'s [associated Document](#), if *global* is a [Window](#) object; otherwise null.
3. [Queue a task](#) given *source*, *event loop*, *document*, and *steps*.

To *queue an element task* on a [task source](#) source, with an element *element* and a series of steps *steps*:

1. Let *global* be *element*'s [relevant global object](#).
2. [Queue a global task](#) given *source*, *global*, and *steps*.

To *queue a microtask* which performs a series of steps *steps*, optionally given an event loop *event loop* and a document *document*:

1. If *event loop* was not given, set *event loop* to the [implied event loop](#).
2. If *document* was not given, set *document* to the [implied document](#).
3. Let *microtask* be a new [task](#).
4. Set *microtask*'s [steps](#) to *steps*.
5. Set *microtask*'s [source](#) to the *microtask* *task source*.
6. Set *microtask*'s [document](#) to *document*.
7. Set *microtask*'s [script evaluation environment settings object set](#) to an empty [set](#).
8. [Enqueue](#) *microtask* on *event loop*'s [microtask queue](#).

It is possible for a [microtask](#) to be moved to a regular [task queue](#), if, during its initial execution, it [spins the event loop](#). This is the only case in which the [source](#), [document](#), and [script evaluation environment settings object set](#) of the microtask are consulted; they are ignored by

the [perform a microtask checkpoint](#) algorithm.

The *implied event loop* when queuing a task is the one that can be deduced from the context of the calling algorithm. This is generally unambiguous, as most specification algorithms only ever involve a single [agent](#) (and thus a single [event loop](#)). The exception is algorithms involving or specifying cross-agent communication (e.g., between a window and a worker); for those cases, the [implied event loop](#) concept must not be relied upon and specifications must explicitly provide an [event loop](#) when [queuing a task](#) or [microtask](#).

The *implied document* when queuing a task on an [event loop](#) *event loop* is determined as follows:

1. If *event loop* is not a [window event loop](#), then return null.
2. If the task is being queued in the context of an element, then return the element's [node document](#).
3. If the task is being queued in the context of a [browsing context](#), then return the browsing context's [active document](#).
4. If the task is being queued by or for a [script](#), then return the script's [settings object](#)'s [responsible document](#).
5. Assert: this step is never reached, because one of the previous conditions must be true. Really?

Both [implied event loop](#) and [implied document](#) are vaguely-defined and have a lot of action-at-a-distance. The hope is to remove these, especially [implied document](#). See [issue #4980](#).

#### 8.1.6.3 Processing model

An [event loop](#) must continually run through the following steps for as long as it exists:

1. Let *taskQueue* be one of the [event loop](#)'s [task queues](#), chosen in an [implementation-defined](#) manner, with the constraint that the chosen task queue must contain at least one [Runnable task](#). If there is no such task queue, then jump to the *microtasks* step below.

Remember that the [microtask queue](#) is not a [task queue](#), so it will not be chosen in this step. However, a [task queue](#) to which the [microtask task source](#) is associated might be chosen in this step. In that case, the [task](#) chosen in the next step was originally a [microtask](#), but it got moved as part of [spinning the event loop](#).

2. Let *oldestTask* be the first [Runnable task](#) in *taskQueue*, and [remove](#) it from *taskQueue*.
3. Set the [event loop](#)'s [currently running task](#) to *oldestTask*.
4. Let *taskStartTime* be the [current high resolution time](#).

5. Perform *oldestTask*'s [steps](#).
6. Set the [event loop](#)'s [currently running task](#) back to null.
7. *Microtasks*: [Perform a microtask checkpoint](#).
8. Let *hasARenderingOpportunity* be false.
9. Let *now* be the [current high resolution time](#). [\[HRT\]](#)
10. Report the [task](#)'s duration by performing the following steps:
  1. Let *top-level browsing contexts* be an empty [set](#).
  2. For each [environment settings object](#) *settings* of *oldestTask*'s [script evaluation environment settings object set](#), [append](#) *setting*'s [top-level browsing context](#) to *top-level browsing contexts*.
  3. [Report long tasks](#), passing in *taskStartTime*, *now* (the end time of the task), *top-level browsing contexts*, and *oldestTask*.
11. *Update the rendering*: if this is a [window event loop](#), then:
  1. Let *docs* be all [Document](#) objects whose [relevant agent](#)'s [event loop](#) is this event loop, sorted arbitrarily except that the following conditions must be met:
    - Any [Document](#) *B* whose [browsing context](#)'s [container document](#) is *A* must be listed after *A* in the list.
    - If there are two documents *A* and *B* whose [browsing contexts](#) are both [child browsing contexts](#) whose [container documents](#) are another [Document](#) *C*, then the order of *A* and *B* in the list must match the [shadow-including tree order](#) of their respective [browsing context containers](#) in *C*'s [node tree](#).

In the steps below that iterate over *docs*, each [Document](#) must be processed in the order it is found in the list.

2. *Rendering opportunities*: Remove from *docs* all [Document](#) objects whose [browsing context](#) do not have a [rendering opportunity](#).

A [browsing context](#) has a *rendering opportunity* if the user agent is currently able to present the contents of the [browsing context](#) to the user, accounting for hardware refresh rate constraints and user agent throttling for performance reasons, but considering content presentable even if it's outside the viewport.

[Browsing context rendering opportunities](#) are determined based on hardware constraints such as display refresh rates and other factors such as page

performance or whether the document's [visibility state](#) is "visible". Rendering opportunities typically occur at regular intervals.

This specification does not mandate any particular model for selecting rendering opportunities. But for example, if the browser is attempting to achieve a 60Hz refresh rate, then rendering opportunities occur at a maximum of every 60th of a second (about 16.7ms). If the browser finds that a [browsing context](#) is not able to sustain this rate, it might drop to a more sustainable 30 rendering opportunities per second for that [browsing context](#), rather than occasionally dropping frames. Similarly, if a [browsing context](#) is not visible, the user agent might decide to drop that page to a much slower 4 rendering opportunities per second, or even less.

3. If *docs* is not empty, then set *hasARenderingOpportunity* to true and set this event loop's [last render opportunity time](#) to *taskStartTime*.
4. *Unnecessary rendering*: Remove from *docs* all [Document](#) objects which meet both of the following conditions:
  - The user agent believes that updating the rendering of the [Document](#)'s [browsing context](#) would have no visible effect, and
  - The [Document](#)'s [map of animation frame callbacks](#) is empty.
5. Remove from *docs* all [Document](#) objects for which the user agent believes that it's preferable to skip updating the rendering for other reasons.

The step labeled *Rendering opportunities* prevents the user agent from updating the rendering when it is unable to present new content to the user (there's no [rendering opportunity](#)).

The step labeled *Unnecessary rendering* prevents the user agent from updating the rendering when there's no new content to draw.

This step enables the user agent to prevent the steps below from running for other reasons, for example, to ensure certain [tasks](#) are executed immediately after each other, with only [microtask checkpoints](#) interleaved (and without, e.g., [animation frame callbacks](#) interleaved). Concretely, a user agent might wish to coalesce timer callbacks together, with no intermediate rendering updates.

6. For each [fully active Document](#) in *docs*, [flush autofocus candidates](#) for that [Document](#) if its [browsing context](#) is a [top-level browsing context](#).
7. For each [fully active Document](#) in *docs*, [run the resize steps](#) for that [Document](#), passing in *now* as the timestamp. [\[CSSOMVIEW\]](#)
8. For each [fully active Document](#) in *docs*, [run the scroll steps](#) for that [Document](#), passing in *now* as the timestamp. [\[CSSOMVIEW\]](#)

9. For each [fully active Document](#) in *docs*, [evaluate media queries and report changes](#) for that [Document](#), passing in *now* as the timestamp. [\[CSSOMVIEW\]](#)
10. For each [fully active Document](#) in *docs*, [update animations and send events](#) for that [Document](#), passing in *now* as the timestamp. [\[WEBANIMATIONS\]](#)
11. For each [fully active Document](#) in *docs*, [run the fullscreen steps](#) for that [Document](#), passing in *now* as the timestamp. [\[FULLSCREEN\]](#)
12. For each [fully active Document](#) in *docs*, if the user agent detects that the backing storage associated with a [CanvasRenderingContext2D](#) or an [OffscreenCanvasRenderingContext2D](#), *context*, has been lost, then it must run the *context lost steps* for each such *context*:
  1. Let *canvas* be the value of *context*'s [canvas](#) attribute, if *context* is a [CanvasRenderingContext2D](#), or the [associated OffscreenCanvas object](#) for *context* otherwise.
  2. Set *context*'s [context lost](#) to true.
  3. [Reset the rendering context to its default state given context](#).
  4. Let *shouldRestore* be the result of [firing an event](#) named [contextlost](#) at *canvas*, with the [cancelable](#) attribute initialized to true.
  5. If *shouldRestore* is false, then abort these steps.
  6. Attempt to restore *context* by creating a backing storage using *context*'s attributes and associating them with *context*. If this fails, then abort these steps.
  7. Set *context*'s [context lost](#) to false.
  8. [Fire an event](#) named [contextrestored](#) at *canvas*.
13. For each [fully active Document](#) in *docs*, [run the animation frame callbacks](#) for that [Document](#), passing in *now* as the timestamp.
14. For each [fully active Document](#) in *docs*, [run the update intersection observations steps](#) for that [Document](#), passing in *now* as the timestamp. [\[INTERSECTIONOBSERVER\]](#)
15. Invoke the [mark paint timing](#) algorithm for each [Document](#) object in *docs*.
16. For each [fully active Document](#) in *docs*, update the rendering or user interface of that [Document](#) and its [browsing context](#) to reflect the current state.

12. If all of the following are true

- this is a [window event loop](#)
- there is no [task](#) in this [event loop](#)'s [task queues](#) whose [document](#) is [fully active](#)
- this [event loop](#)'s [microtask queue](#) is [empty](#)
- [hasARenderingOpportunity](#) is false

then:

1. Let *computeDeadline* be the following steps:

1. Let *deadline* be this [event loop](#)'s [last idle period start time](#) plus 50.

The cap of 50ms in the future is to ensure responsiveness to new user input within the threshold of human perception.

2. Let *hasPendingRenders* be false.

3. For each *windowInSameLoop* of the [same-loop windows](#) for this [event loop](#):

1. If *windowInSameLoop*'s [map of animation frame callbacks](#) is not [empty](#), or if the user agent believes that the *windowInSameLoop* might have pending rendering updates, set *hasPendingRenders* to true.

2. Let *timerCallbackEstimates* be the result of [getting the values](#) of *windowInSameLoop*'s [map of active timers](#).

3. For each *timeoutDeadline* of *timerCallbackEstimates*, if *timeoutDeadline* is less than *deadline*, set *deadline* to *timeoutDeadline*.

4. If *hasPendingRenders* is true, then:

1. Let *nextRenderDeadline* be this [event loop](#)'s [last render opportunity time](#) plus (1000 divided by the current refresh rate).

The refresh rate can be hardware- or implementation-specific. For a refresh rate of 60Hz, the *nextRenderDeadline* would be about 16.67ms after the [last render opportunity time](#).

2. If *nextRenderDeadline* is less than *deadline*, then return *nextRenderDeadline*.

5. Return *deadline*.

2. For each *win* of the [same-loop windows](#) for this [event loop](#), perform the [start an](#)

[idle period algorithm](#) for *win* with *computeDeadline*.  
[REQUESTIDLECALLBACK]

13. If this is a [worker event loop](#), then:

1. If this [event loop's agent](#)'s single [realm's global object](#) is a [supported DedicatedWorkerGlobalScope](#) and the user agent believes that it would benefit from having its rendering updated at this time, then:
  1. Let *now* be the [current high resolution time](#). [HRT]
  2. [Run the animation frame callbacks](#) for that [DedicatedWorkerGlobalScope](#), passing in *now* as the timestamp.
  3. Update the rendering of that dedicated worker to reflect the current state.

Similar to the notes for [updating the rendering](#) in a [window event loop](#), a user agent can determine the rate of rendering in the dedicated worker.

2. If there are no [tasks](#) in the [event loop's task queues](#) and the [WorkerGlobalScope](#) object's [closing](#) flag is true, then destroy the [event loop](#), aborting these steps, resuming the [run a worker](#) steps described in the [Web workers](#) section below.
- 

When a user agent is to *perform a microtask checkpoint*:

1. If the [event loop's performing a microtask checkpoint](#) is true, then return.
2. Set the [event loop's performing a microtask checkpoint](#) to true.
3. While the [event loop's microtask queue](#) is not [empty](#):
  1. Let *oldestMicrotask* be the result of [dequeuing](#) from the [event loop's microtask queue](#).
  2. Set the [event loop's currently running task](#) to *oldestMicrotask*.
  3. Run *oldestMicrotask*.

This might involve invoking scripted callbacks, which eventually calls the [clean up after running script](#) steps, which call this [perform a microtask checkpoint](#) algorithm again, which is why we use the [performing a microtask checkpoint](#) flag to avoid reentrancy.

4. Set the [event loop's currently running task](#) back to null.

4. For each [environment settings object](#) whose [responsible event loop](#) is this [event loop](#), [notify about rejected promises](#) on that [environment settings object](#).
5. [Cleanup Indexed Database transactions](#).
6. Perform [ClearKeptObjects\(\)](#).

When [WeakRef.prototype.deref\(\)](#) returns an object, that object is kept alive until the next invocation of [ClearKeptObjects\(\)](#), after which it is again subject to garbage collection.

7. Set the [event loop's performing a microtask checkpoint](#) to false.
- 

When an algorithm running [in parallel](#) is to *await a stable state*, the user agent must [queue a microtask](#) that runs the following steps, and must then stop executing (execution of the algorithm resumes when the microtask is run, as described in the following steps):

1. Run the algorithm's *synchronous section*.
2. Resumes execution of the algorithm [in parallel](#), if appropriate, as described in the algorithm's steps.

Steps in [synchronous sections](#) are marked with ☒.

---

Algorithm steps that say to *spin the event loop* until a condition *goal* is met are equivalent to substituting in the following algorithm steps:

1. Let *task* be the [event loop's currently running task](#).  
*task* could be a [microtask](#).
2. Let *task source* be *task*'s [source](#).
3. Let *old stack* be a copy of the [JavaScript execution context stack](#).
4. Empty the [JavaScript execution context stack](#).
5. [Perform a microtask checkpoint](#).

If *task* is a [microtask](#) this step will be a no-op due to [performing a microtask checkpoint](#) being true.

6. [In parallel](#):
  1. Wait until the condition *goal* is met.

2. [Queue a task](#) on *task source* to:

1. Replace the [JavaScript execution context stack](#) with *old stack*.
2. Perform any steps that appear after this [spin the event loop](#) instance in the original algorithm.

This resumes *task*.

7. Stop *task*, allowing whatever algorithm that invoked it to resume.

This causes the [event loop](#)'s main set of steps or the [perform a microtask checkpoint](#) algorithm to continue.

Unlike other algorithms in this and other specifications, which behave similar to programming-language function calls, [spin the event loop](#) is more like a macro, which saves typing and indentation at the usage site by expanding into a series of steps and operations.

An algorithm whose steps are:

1. Do something.
2. [Spin the event loop](#) until awesomeness happens.
3. Do something else.

is a shorthand which, after "macro expansion", becomes

1. Do something.
2. Let *old stack* be a copy of the [JavaScript execution context stack](#).
3. Empty the [JavaScript execution context stack](#).
4. [Perform a microtask checkpoint](#).
5. [In parallel](#):
  1. Wait until awesomeness happens.
  2. [Queue a task](#) on the task source in which "do something" was done to:
    1. Replace the [JavaScript execution context stack](#) with *old stack*.
    2. Do something else.

Here is a more full example of the substitution, where the event loop is spun from inside a task that is queued from work in parallel. The version using [spin the event loop](#):

1. [In parallel](#):

1. Do parallel thing 1.
2. [Queue a task](#) on the [DOM manipulation task source](#) to:
  1. Do task thing 1.
  2. [Spin the event loop](#) until awesomeness happens.
  3. Do task thing 2.
3. Do parallel thing 2.

The fully expanded version:

1. [In parallel](#):

1. Do parallel thing 1.
2. Let *old stack* be null.
3. [Queue a task](#) on the [DOM manipulation task source](#) to:
  1. Do task thing 1.
  2. Set *old stack* to a copy of the [JavaScript execution context stack](#).
  3. Empty the [JavaScript execution context stack](#).
  4. [Perform a microtask checkpoint](#).
4. Wait until awesomeness happens.
5. [Queue a task](#) on the [DOM manipulation task source](#) to:
  1. Replace the [JavaScript execution context stack](#) with *old stack*.
  2. Do task thing 2.
6. Do parallel thing 2.

---

Some of the algorithms in this specification, for historical reasons, require the user agent to *pause* while running a [task](#) until a condition *goal* is met. This means running the following steps:

1. If necessary, update the rendering or user interface of any [Document](#) or [browsing](#)

[context](#) to reflect the current state.

2. Wait until the condition *goal* is met. While a user agent has a paused [task](#), the corresponding [event loop](#) must not run further [tasks](#), and any script in the currently running [task](#) must block. User agents should remain responsive to user input while paused, however, albeit in a reduced capacity since the [event loop](#) will not be doing anything.

[Pausing](#) is highly detrimental to the user experience, especially in scenarios where a single [event loop](#) is shared among multiple documents. User agents are encouraged to experiment with alternatives to [pausing](#), such as [spinning the event loop](#) or even simply proceeding without any kind of suspended execution at all, insofar as it is possible to do so while preserving compatibility with existing content. This specification will happily change if a less-drastic alternative is discovered to be web-compatible.

In the interim, implementers should be aware that the variety of alternatives that user agents might experiment with can change subtle aspects of [event loop](#) behavior, including [task](#) and [microtask](#) timing. Implementations should continue experimenting even if doing so causes them to violate the exact semantics implied by the [pause](#) operation.

#### 8.1.6.4 Generic task sources

The following [task sources](#) are used by a number of mostly unrelated features in this and other specifications.

##### The *DOM manipulation task source*

This [task source](#) is used for features that react to DOM manipulations, such as things that happen in a non-blocking fashion when an element is [inserted into the document](#).

##### The *user interaction task source*

This [task source](#) is used for features that react to user interaction, for example keyboard or mouse input.

Events sent in response to user input (e.g. [click](#) events) must be fired using [tasks queued](#) with the [user interaction task source](#). [\[UIEVENTS\]](#)

##### The *networking task source*

This [task source](#) is used for features that trigger in response to network activity.

##### The *history traversal task source*

This [task source](#) is used to queue calls to [history.back\(\)](#) and similar APIs.

### 8.1.6.5 Dealing with the event loop from other specifications

Writing specifications that correctly interact with the [event loop](#) can be tricky. This is compounded by how this specification uses concurrency-model-independent terminology, so we say things like "[event loop](#)" and "[in parallel](#)" instead of using more familiar model-specific terms like "main thread" or "on a background thread".

By default, specification text generally runs on the [event loop](#). This falls out from the formal [event loop processing model](#), in that you can eventually trace most algorithms back to a [task queued](#) there.

The algorithm steps for any JavaScript method will be invoked by author code calling that method. And author code can only be run via queued tasks, usually originating somewhere in the [script processing model](#).

From this starting point, the overriding guideline is that any work a specification needs to perform that would otherwise block the [event loop](#) must instead be performed [in parallel](#) with it. This includes (but is not limited to):

- performing heavy computation;
- displaying a user-facing prompt;
- performing operations which could require involving outside systems (i.e. "going out of process").

The next complication is that, in algorithm sections that are [in parallel](#), you must not create or manipulate objects associated to a specific [JavaScript realm](#), [global](#), or [environment settings object](#). (Stated in more familiar terms, you must not directly access main-thread artifacts from a background thread.) Doing so would create data races observable to JavaScript code, since after all, your algorithm steps are running [in parallel](#) to the JavaScript code.

You can, however, manipulate specification-level data structures and values from *Infra*, as those are realm-agnostic. They are never directly exposed to JavaScript without a specific conversion taking place (often [via Web IDL](#)). [\[INFRA\]](#) [\[WEBIDL\]](#)

To affect the world of observable JavaScript objects, then, you must [queue a global task](#) to perform any such manipulations. This ensures your steps are properly interleaved with respect to other things happening on the [event loop](#). Furthermore, you must choose a [task source](#) when [queuing a global task](#); this governs the relative order of your steps versus others. If you are unsure which [task source](#) to use, pick one of the [generic task sources](#) that sounds most applicable. Finally, you must indicate which [global object](#) your queued task is associated with; this ensures that if that global object is inactive, the task does not run.

The base primitive, on which [queue a global task](#) builds, is the [queue a task](#) algorithm. In general, [queue a global task](#) is better because it automatically picks the right [event loop](#) and, where appropriate, [document](#). Older specifications often use [queue a task](#) combined with the [implied event loop](#) and [implied document](#) concepts, but this is discouraged.

Putting this all together, we can provide a template for a typical algorithm that needs to do work asynchronously:

1. Do any synchronous setup work, while still on the [event loop](#). This may include converting [realm](#)-specific JavaScript values into realm-agnostic specification-level values.
2. Perform a set of potentially-expensive steps [in parallel](#), operating entirely on realm-agnostic values, and producing a realm-agnostic result.
3. [Queue a global task](#), on a specified [task source](#) and given an appropriate [global object](#), to convert the realm-agnostic result back into observable effects on the observable world of JavaScript objects on the [event loop](#).

The following is an algorithm that "encrypts" a passed-in [list](#) of [scalar value strings](#) *input*, after parsing them as URLs:

1. Let *urls* be an empty [list](#).
2. [For each](#) *string* of *input*:
  1. Let *parsed* be the result of [parsing](#) *string* relative to the [current settings object](#).
  2. If *parsed* is failure, return a promise rejected with a ["SyntaxError"](#) [DOMException](#).
  3. Let *serialized* be the result of applying the [URL serializer](#) to *parsed*.
  4. [Append](#) *serialized* to *urls*.
3. Let *realm* be the [current Realm Record](#).
4. Let *p* be a new promise.
5. Run the following steps [in parallel](#):
  1. Let *encryptedURLs* be an empty [list](#).
  2. [For each](#) *url* of *urls*:
    1. Wait 100 milliseconds, so that people think we're doing heavy-duty encryption.
    2. Let *encrypted* be a new [string](#) derived from *url*, whose *n*th [code unit](#) is equal to *url*'s *n*th [code unit](#) plus 13.
    3. [Append](#) *encrypted* to *encryptedURLs*.

3. Queue a global task on the [networking task source](#), given *realm*'s [global object](#), to perform the following steps:
  1. Let *array* be the result of [converting](#) *encryptedURLs* to a JavaScript array, in *realm*.
  2. Resolve *p* with *array*.
6. Return *p*.

Here are several things to notice about this algorithm:

- It does its URL parsing up front, on the [event loop](#), before going to the [in parallel](#) steps. This is necessary, since parsing depends on the [current settings object](#), which would no longer be current after going [in parallel](#).
- Alternately, it could have saved a reference to the [current settings object's API base URL](#) and used it during the [in parallel](#) steps; that would have been equivalent. However, we recommend instead doing as much work up front, as this example does. Attempting to save the correct values can be error prone; for example, if we'd saved just the [current settings object](#), instead of its [API base URL](#), there would have been a potential race.
- It implicitly passes a [list of strings](#) from the initial steps to the [in parallel](#) steps. This is OK, as both [lists](#) and [strings](#) are [realm-agnostic](#).
- It performs "expensive computation" (waiting for 100 milliseconds per input URL) during the [in parallel](#) steps, thus not blocking the main [event loop](#).
- Promises, as observable JavaScript objects, are never created and manipulated during the [in parallel](#) steps. *p* is created before entering those steps, and then is manipulated during a [task](#) that is [queued](#) specifically for that purpose.
- The creation of a JavaScript array object also happens during the queued task, and is careful to specify which realm it creates the array in since that is no longer obvious from context.

(On these last two points, see also [whatwg/webidl issue #135](#) and [whatwg/webidl issue #371](#), where we are still mulling over the subtleties of the above promise-resolution pattern.)

Another thing to note is that, in the event this algorithm was called from a Web IDL-specified operation taking a `sequence<USVString>`, there was an automatic conversion from [realm-specific JavaScript objects](#) provided by the author as input, into the [realm-agnostic sequence<USVString>](#) Web IDL type, which we then treat as a [list of scalar value strings](#). So depending on how your specification is structured, there may be other implicit steps happening on the main [event loop](#) that play a part in this whole process of getting you ready to go [in parallel](#).

## 8.1.7 Events

### 8.1.7.1 Event handlers

MDN

#### [Events/Event\\_handlers](#)

Many objects can have *event handlers* specified. These act as non-capture [event listeners](#) for the object on which they are specified. [\[DOM\]](#)

An [event handler](#) is a [struct](#) with two [items](#):

- a *value*, which is either null, a callback object, or an [internal raw uncompiled handler](#). The [EventHandler](#) callback function type describes how this is exposed to scripts. Initially, an [event handler's value](#) must be set to null.
- a *listener*, which is either null or an [event listener](#) responsible for running [the event handler processing algorithm](#). Initially, an [event handler's listener](#) must be set to null.

Event handlers are exposed in two ways.

The first way, common to all event handlers, is as an [event handler IDL attribute](#).

The second way is as an [event handler content attribute](#). Event handlers on [HTML elements](#) and some of the event handlers on [Window](#) objects are exposed in this way.

For both of these two ways, the [event handler](#) is exposed through a *name*, which is a string that always starts with "on" and is followed by the name of the event for which the handler is intended.

---

Most of the time, the object that exposes an [event handler](#) is the same as the object on which the corresponding [event listener](#) is added. However, the [body](#) and [frameset](#) elements expose several [event handlers](#) that act upon the element's [Window](#) object, if one exists. In either case, we call the object an [event handler](#) acts upon the *target* of that [event handler](#).

To determine the *target* of an [event handler](#), given an [EventTarget](#) object *eventTarget* on which the [event handler](#) is exposed, and an [event handler name](#) *name*, the following steps are taken:

1. If *eventTarget* is not a [body](#) element or a [frameset](#) element, then return *eventTarget*.
2. If *name* is not the name of an attribute member of the [WindowEventHandlers](#) interface mixin and the [Window](#)-reflecting [body](#) element event handler set does not [contain](#) *name*, then return *eventTarget*.

3. If *eventTarget*'s [node document](#) is not an [active document](#), then return null.

This could happen if this object is a [body](#) element without a corresponding [Window](#) object, for example.

This check does not necessarily prevent [body](#) and [frameset](#) elements that are not [the body element](#) of their [node document](#) from reaching the next step. In particular, a [body](#) element created in an [active document](#) (perhaps with [document.createElement\(\)](#)) but not [connected](#) will also have its corresponding [Window](#) object as the [target](#) of several [event handlers](#) exposed through it.

4. Return *eventTarget*'s [node document](#)'s [relevant global object](#).
- 

Each [EventTarget](#) object that has one or more [event handlers](#) specified has an associated [event handler map](#), which is a [map](#) of strings representing [names](#) of [event handlers](#) to [event handlers](#).

When an [EventTarget](#) object that has one or more [event handlers](#) specified is created, its [event handler map](#) must be initialized such that it contains an [entry](#) for each [event handler](#) that has that object as [target](#), with [items](#) in those [event handlers](#) set to their initial values.

The order of the [entries](#) of [event handler map](#) could be arbitrary. It is not observable through any algorithms that operate on the map.

[Entries](#) are not created in the [event handler map](#) of an object for [event handlers](#) that are merely exposed on that object, but have some other object as their [targets](#).

---

An [event handler IDL attribute](#) is an IDL attribute for a specific [event handler](#). The name of the IDL attribute is the same as the [name](#) of the [event handler](#).

The getter of an [event handler IDL attribute](#) with name *name*, when called, must run these steps:

1. Let *eventTarget* be the result of [determining the target of an event handler](#) given this object and *name*.
2. If *eventTarget* is null, then return null.
3. Return the result of [getting the current value of the event handler](#) given *eventTarget* and *name*.

The setter of an [event handler IDL attribute](#) with name *name*, when called, must run these steps:

1. Let *eventTarget* be the result of [determining the target of an event handler](#) given this

object and *name*.

2. If *eventTarget* is null, then return.
3. If the given value is null, then [deactivate an event handler](#) given *eventTarget* and *name*.
4. Otherwise:
  1. Let *handlerMap* be *eventTarget*'s [event handler map](#).
  2. Let *eventHandler* be *handlerMap*[*name*].
  3. Set *eventHandler*'s [value](#) to the given value.
  4. [Activate an event handler](#) given *eventTarget* and *name*.

Certain [event handler IDL attributes](#) have additional requirements, in particular the [onmessage](#) attribute of [MessagePort](#) objects.

---

An *event handler content attribute* is a content attribute for a specific [event handler](#). The name of the content attribute is the same as the [name](#) of the [event handler](#).

[Event handler content attributes](#), when specified, must contain valid JavaScript code which, when parsed, would match the [FunctionBody](#) production after [automatic semicolon insertion](#).

The following [attribute change steps](#) are used to synchronize between [event handler content attributes](#) and [event handlers](#): [\[DOM\]](#)

1. If *namespace* is not null, or *localName* is not the name of an [event handler content attribute](#) on *element*, then return.
2. Let *eventTarget* be the result of [determining the target of an event handler](#) given *element* and *localName*.
3. If *eventTarget* is null, then return.
4. If *value* is null, then [deactivate an event handler](#) given *eventTarget* and *localName*.
5. Otherwise:
  1. If the [Should element's inline behavior be blocked by Content Security Policy?](#) algorithm returns "Blocked" when executed upon *element*, "script attribute", and *value*, then return. [\[CSP\]](#)
  2. Let *handlerMap* be *eventTarget*'s [event handler map](#).

3. Let *eventHandler* be *handlerMap*[*localName*].
4. Let *location* be the script location that triggered the execution of these steps.
5. Set *eventHandler*'s [value](#) to the [internal raw uncompiled handler](#) *value/location*.
6. [Activate an event handler](#) given *eventTarget* and *localName*.

Per the DOM Standard, these steps are run even if *oldValue* and *value* are identical (setting an attribute to its current value), but *not* if *oldValue* and *value* are both null (removing an attribute that doesn't currently exist). [\[DOM\]](#)

---

To deactivate an event handler given an [EventTarget](#) object *eventTarget* and a string *name* that is the [name](#) of an [event handler](#), run these steps:

1. Let *handlerMap* be *eventTarget*'s [event handler map](#).
2. Let *eventHandler* be *handlerMap*[*name*].
3. Set *eventHandler*'s [value](#) to null.
4. Let *listener* be *eventHandler*'s [listener](#).
5. If *listener* is not null, then [remove an event listener](#) with *eventTarget* and *listener*.
6. Set *eventHandler*'s [listener](#) to null.

To erase all event listeners and handlers given an [EventTarget](#) object *eventTarget*, run these steps:

1. If *eventTarget* has an associated [event handler map](#), then for each *name* → *eventHandler* of *eventTarget*'s associated [event handler map](#), [deactivate an event handler](#) given *eventTarget* and *name*.
2. [Remove all event listeners](#) given *eventTarget*.

This algorithm is used to define [document.open\(\)](#).

To activate an event handler given an [EventTarget](#) object *eventTarget* and a string *name* that is the [name](#) of an [event handler](#), run these steps:

1. Let *handlerMap* be *eventTarget*'s [event handler map](#).
2. Let *eventHandler* be *handlerMap*[*name*].
3. If *eventHandler*'s [listener](#) is not null, then return.

4. Let `callback` be the result of creating a Web IDL [EventListener](#) instance representing a reference to a function of one argument that executes the steps of [the event handler processing algorithm](#), given `eventTarget`, `name`, and its argument.

The [EventListener](#)'s [callback context](#) can be arbitrary; it does not impact the steps of [the event handler processing algorithm](#). [DOM]

The callback is emphatically *not* the [event handler](#) itself. Every event handler ends up registering the same callback, the algorithm defined below, which takes care of invoking the right code, and processing the code's return value.

5. Let `listener` be a new [event listener](#) whose `type` is the [event handler event type](#) corresponding to `eventHandler` and [callback](#) is `callback`.

To be clear, an [event listener](#) is different from an [EventListener](#).

6. [Add an event listener](#) with `eventTarget` and `listener`.

7. Set `eventHandler`'s [listener](#) to `listener`.

The event listener registration happens only if the [event handler's value](#) is being set to non-null, and the [event handler](#) is not already activated. Since listeners are called in the order they were registered, assuming no [deactivation](#) occurred, the order of event listeners for a particular event type will always be:

1. the event listeners registered with [addEventListener\(\)](#) before the first time the [event handler's value](#) was set to non-null
2. then the callback to which it is currently set, if any
3. and finally the event listeners registered with [addEventListener\(\)](#) after the first time the [event handler's value](#) was set to non-null.

This example demonstrates the order in which event listeners are invoked. If the button in this example is clicked by the user, the page will show four alerts, with the text "ONE", "TWO", "THREE", and "FOUR" respectively.

```
<button id="test">Start Demo</button>
<script>
 var button = document.getElementById('test');
 button.addEventListener('click', function () { alert('ONE') }, false);
 button.setAttribute('onclick', "alert('NOT CALLED')"); // event handler listed
 button.addEventListener('click', function () { alert('THREE') }, false);
 button.onclick = function () { alert('TWO') };
 button.addEventListener('click', function () { alert('FOUR') }, false);
</script>
```

However, in the following example, the event handler is [deactivated](#) after its initial activation

(and its event listener is removed), before being reactivated at a later time. The page will show five alerts with "ONE", "TWO", "THREE", "FOUR", and "FIVE" respectively, in order.

```
<button id="test">Start Demo</button>
<script>
var button = document.getElementById('test');
button.addEventListener('click', function () { alert('ONE') }, false);
button.setAttribute('onclick', "alert('NOT CALLED')"); // event handler is added
button.addEventListener('click', function () { alert('TWO') }, false);
button.onclick = null; // but deactivated here
button.addEventListener('click', function () { alert('THREE') }, false);
button.onclick = function () { alert('FOUR'); }; // and re-activated here
button.addEventListener('click', function () { alert('FIVE') }, false);
</script>
```

The interfaces implemented by the event object do not influence whether an [event handler](#) is triggered or not.

*The event handler processing algorithm* for an [EventTarget](#) object `eventTarget`, a string `name` representing the [name](#) of an [event handler](#), and an [Event](#) object `event` is as follows:

1. Let `callback` be the result of [getting the current value of the event handler](#) given `eventTarget` and `name`.
2. If `callback` is null, then return.
3. Let *special error event handling* be true if `event` is an [ErrorEvent](#) object, `event's type` is [error](#), and `event's currentTarget` implements the [WindowOrWorkerGlobalScope](#) mixin. Otherwise, let *special error event handling* be false.
4. Process the [Event](#) object `event` as follows:

If *special error event handling* is true

[Invoke](#) `callback` with five arguments, the first one having the value of `event's message` attribute, the second having the value of `event's filename` attribute, the third having the value of `event's lineno` attribute, the fourth having the value of `event's colno` attribute, the fifth having the value of `event's error` attribute, and with the [callback this value](#) set to `event's currentTarget`. Let `return value` be the callback's return value. [\[WEBIDL\]](#)

Otherwise

[Invoke](#) `callback` with one argument, the value of which is the [Event](#) object `event`, with the [callback this value](#) set to `event's currentTarget`. Let `return value` be the callback's return value. [\[WEBIDL\]](#)

If an exception gets thrown by the callback, end these steps and allow the exception to propagate. (It will propagate to the [DOM event dispatch logic](#), which will then [report the exception](#).)

5. Process *return value* as follows:

If *event* is a [\*\*BeforeUnloadEvent\*\*](#) object and *event's type* is [\*\*beforeunload\*\*](#)

In this case, the [event handler IDL attribute](#)'s type will be [\*\*OnBeforeUnloadEventHandler\*\*](#), so *return value* will have been coerced into either null or a [\*\*DOMString\*\*](#).

If *return value* is not null, then:

1. Set *event's canceled flag*.
2. If *event's returnValue* attribute's value is the empty string, then set *event's returnValue* attribute's value to *return value*.

If *special error event handling* is true

If *return value* is true, then set *event's canceled flag*.

Otherwise

If *return value* is false, then set *event's canceled flag*.

If we've gotten to this "Otherwise" clause because *event's type* is [\*\*beforeunload\*\*](#) but *event* is *not* a [\*\*BeforeUnloadEvent\*\*](#) object, then *return value* will never be false, since in such cases *return value* will have been coerced into either null or a [\*\*DOMString\*\*](#).

---

The [\*\*EventHandler\*\*](#) callback function type represents a callback used for event handlers. It is represented in Web IDL as follows:

```
[LegacyTreatNonObjectAsNull]
callback EventHandlerNonNull = any (Event event);
typedef EventHandlerNonNull? EventHandler;
```

In JavaScript, any [\*\*Function\*\*](#) object implements this interface.

For example, the following document fragment:

```
<body onload="alert(this)" onclick="alert(this)">
```

...leads to an alert saying "[object Window]" when the document is loaded, and an alert saying "[object HTMLElement]" whenever the user clicks something in the page.

The return value of the function affects whether the event is canceled or not: as described above, if the return value is false, the event is canceled.

There are two exceptions in the platform, for historical reasons:

- The [onerror](#) handlers on global objects, where returning *true* cancels the event.
- The [onbeforeunload](#) handler, where returning any non-null and non-undefined value will cancel the event.

For historical reasons, the [onerror](#) handler has different arguments:

[[LegacyTreatNonObjectAsNull](#)]

```
callback OnErrorEventHandlerNonNull = any ((Event or DOMString) event, optional
typedef OnErrorHandlerNonNull? OnErrorHandler;
```

```
window.onerror = (message, source, lineno, colno, error) => { ... };
```

Similarly, the [onbeforeunload](#) handler has a different return value:

[[LegacyTreatNonObjectAsNull](#)]

```
callback OnBeforeUnloadEventHandlerNonNull = DOMString? (Event event);
typedef OnBeforeUnloadHandlerNonNull? OnBeforeUnloadEventHandler;
```

---

An *internal raw uncompiled handler* is a tuple with the following information:

- An uncompiled script body
- A location where the script body originated, in case an error needs to be reported

When the user agent is to get the current value of the event handler given an [EventTarget](#) object *eventTarget* and a string *name* that is the [name](#) of an [event handler](#), it must run these steps:

1. Let *handlerMap* be *eventTarget*'s [event handler map](#).
2. Let *eventHandler* be *handlerMap*[*name*].
3. If *eventHandler*'s [value](#) is an [internal raw uncompiled handler](#), then:
  1. If *eventTarget* is an element, then let *element* be *eventTarget*, and *document* be *element*'s [node document](#). Otherwise, *eventTarget* is a [Window](#) object, let *element* be null, and *document* be *eventTarget*'s [associated Document](#).
  2. If [scripting is disabled](#) for *document*, then return null.
  3. Let *body* be the uncompiled script body in *eventHandler*'s [value](#).

4. Let *location* be the location where the script body originated, as given by *eventHandler*'s [value](#).
5. If *element* is not null and *element* has a [form owner](#), let *form owner* be that [form owner](#). Otherwise, let *form owner* be null.
6. Let *settings object* be the [relevant settings object](#) of *document*.
7. If *body* is not parseable as [FunctionBody](#) or if parsing detects an [early error](#), then follow these substeps:

1. Set *eventHandler*'s [value](#) to null.

This does not [deactivate](#) the event handler, which additionally [removes](#) the event handler's [listener](#) (if present).

2. [Report the error](#) for the appropriate [script](#) and with the appropriate position (line number and column number) given by *location*, using *settings object*'s [global object](#). If the error is still [not handled](#) after this, then the error may be reported to a developer console.

3. Return null.

8. Push *settings object*'s [realm](#) execution context onto the [JavaScript execution context stack](#); it is now the [running JavaScript execution context](#).

This is necessary so the subsequent invocation of [OrdinaryFunctionCreate](#) takes place in the correct [JavaScript Realm](#).

9. Let *function* be the result of calling [OrdinaryFunctionCreate](#), with arguments:

*functionPrototype*  
[%Function.prototype%](#)

*sourceText*

If *name* is [onerror](#) and *eventTarget* is a [Window](#) object

The string formed by concatenating "function ", *name*, "(*event*, *source*, *lineno*, *colno*, *error*) {", U+000A LF, *body*, U+000A LF, and "}".

Otherwise

The string formed by concatenating "function ", *name*, "(*event*) {", U+000A LF, *body*, U+000A LF, and "}".

*ParameterList*

If *name* is [onerror](#) and *eventTarget* is a [Window](#) object

Let the function have five arguments, named **event**, **source**, **lineno**, **colno**, and **error**.

**Otherwise**

Let the function have a single argument called **event**.

**body**

The result of parsing *body* above.

**thisMode**

non-lexical-this

**scope**

1. Let *realm* be *settings object*'s [Realm](#).
2. Let *scope* be *realm*.[[GlobalEnv]].
3. If *eventHandler* is an element's [event handler](#), then set *scope* to [NewObjectEnvironment](#)(*document*, true, *scope*).  
(Otherwise, *eventHandler* is a [Window](#) object's [event handler](#).)

4. If *form owner* is not null, then set *scope* to [NewObjectEnvironment](#)(*form owner*, true, *scope*).
5. If *element* is not null, then set *scope* to [NewObjectEnvironment](#)(*element*, true, *scope*).
6. Return *scope*.

10. Remove *settings object*'s [realm execution context](#) from the [JavaScript execution context stack](#).
11. Set *function*.[[ScriptOrModule]] to null.

This is done because the default behavior, of associating the created function with the nearest [script](#) on the stack, can lead to path-dependent results. For example, an event handler which is first invoked by user interaction would end up with null [[ScriptOrModule]] (since then this algorithm would be first invoked when the [active script](#) is null), whereas one that is first invoked by dispatching an event from script would have its [[ScriptOrModule]] set to that script.

Instead, we just always set [[ScriptOrModule]] to null. This is more intuitive anyway; the idea that the first script which dispatches an event is somehow responsible for the event handler code is dubious.

In practice, this only affects the resolution of relative URLs via [import\(\)](#), which consult the [base URL](#) of the associated script. Nulling out [[ScriptOrModule]] means that [HostResolveImportedModule](#) and [HostImportModuleDynamically](#) will fall back to the [current settings object](#)'s

[API base URL](#).

12. Set *eventHandler*'s [value](#) to the result of creating a Web IDL [EventHandler](#) callback function object whose object reference is *function* and whose [callback context](#) is *settings object*.

4. Return *eventHandler*'s [value](#).

#### 8.1.7.2 Event handlers on elements, [Document](#) objects, and [Window](#) objects

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported by all [HTML elements](#), as both [event handler content attributes](#) and [event handler IDL attributes](#); and that must be supported by all [Document](#) and [Window](#) objects, as [event handler IDL attributes](#):

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
<i>onabort</i> 	<a href="#">abort</a>
<a href="#">GlobalEventHandlers/onabort</a>	
Support in all current engines.	
Firefox 9+ Safari 1+ Chrome 1+ Opera 12.1+ Edge 79+ Edge (Legacy) 12+ Internet Explorer 9+ Firefox Android 9+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+	<a href="#">abort</a>
<i>onauxclick</i>	<a href="#">auxclick</a>
<i>oncancel</i> 	<a href="#">cancel</a>
<a href="#">GlobalEventHandlers/oncancel</a>	
Support in one engine only.	
Firefox No Safari No Chrome 32+ Opera 19+ Edge 79+ Edge (Legacy) No Internet Explorer No Firefox Android No Safari iOS No Chrome Android 32+ WebView Android 4.4.3+ Samsung Internet 2.0+ Opera Android 19+	<a href="#">cancel</a>
<i>oncanplay</i>	<a href="#">canplay</a>

## [Event handler](#)

## [Event handler event type](#)

✓MDN

### [GlobalEventHandlers/oncanplay](#)

Support in all current engines.

Firefox 9+ Safari 9+ Chrome 32+

Opera 19+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 9+ Chrome

Android 32+ WebView Android 4.4.3+ Samsung

Internet 2.0+ Opera Android 19+

*oncanplaythrough*

✓MDN

### [GlobalEventHandlers/oncanplaythrough](#)

Support in all current engines.

## [canplaythrough](#)

Firefox 9+ Safari 9+ Chrome 32+

Opera 19+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 9+ Chrome

Android 32+ WebView Android 4.4.3+ Samsung

Internet 2.0+ Opera Android 19+

*onchange*

✓MDN

### [GlobalEventHandlers/onchange](#)

Support in all current engines.

## [change](#)

Firefox 1+ Safari 3+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 4+ Safari iOS 1+ Chrome

Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

*onclick*

✓MDN

## [click](#)

### [GlobalEventHandlers/onclick](#)

## [Event handler](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

Opera 9+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome

Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

*onclose*

 MDN

## [GlobalEventHandlers/onclose](#)

Firefox 53+ Safari No Chrome 32+

[close](#)

Opera 19+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 53+ Safari iOS No Chrome

Android 32+ WebView Android 4.4.3+ Samsung

Internet 2.0+ Opera Android 19+

*oncontextlost*

[contextlost](#)

*oncontextmenu*

 ✓ MDN

## [GlobalEventHandlers/oncontextmenu](#)

Support in all current engines.

[contextmenu](#)

Firefox 9+ Safari 4+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 5+

Firefox Android 9+ Safari iOS 3.2+ Chrome

Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 12.1+

*oncontextrestored*

[contextrestored](#)

*oncuechange*

 ✓ MDN

## [GlobalEventHandlers/oncuechange](#)

[cuechange](#)

Support in all current engines.

Firefox 68+ Safari 10.1+ Chrome 32+

## [Event handler event type](#)

## [Event handler](#)

Opera19+Edge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android68+Safari iOS10.3+Chrome

Android32+WebView Android4.4.3+Samsung

Internet2.0+Opera Android19+

*ondblclick*

✓MDN

## [Event handler event type](#)

[dblclick](#)

Firefox9+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android9+Safari iOS1+Chrome

Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

*ondrag*

[drag](#)

*ondragend*

[dragend](#)

*ondragenter*

[dragenter](#)

*ondragleave*

[dragleave](#)

*ondragover*

[dragover](#)

*ondragstart*

[dragstart](#)

*ondrop*

[drop](#)

*ondurationchange*

[durationchange](#)

✓MDN

## [GlobalEventHandlers/ondurationchange](#)

Support in all current engines.

[durationchange](#)

Firefox9+Safari9+Chrome32+

Opera19+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS9+Chrome

Android32+WebView Android4.4.3+Samsung

Internet2.0+Opera Android19+

*onemptied*

[emptied](#)

✓MDN

## [Event handler](#)

## [Event handler event type](#)

### [GlobalEventHandlers/onemptied](#)

Support in all current engines.

Firefox9+Safari9+Chrome32+

Opera19+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS9+Chrome

Android32+WebView Android4.4.3+Samsung

Internet2.0+Opera Android19+

*onended*



### [GlobalEventHandlers/onended](#)

Support in all current engines.

[ended](#)

Firefox9+Safari9+Chrome32+

Opera19+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS9+Chrome

Android32+WebView Android4.4.3+Samsung

Internet2.0+Opera Android19+

*onformdata*



### [GlobalEventHandlers/onformdata](#)

Support in all current engines.

[formdata](#)

Firefox72+Safari15+Chrome77+

Opera64+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android79+Safari iOS15+Chrome

Android77+WebView Android77+Samsung

Internet12.0+Opera Android55+

*oninput*



[input](#)

### [GlobalEventHandlers/oninput](#)

## [Event handler](#)

## [Event handler event type](#)

Support in all current engines.

Firefox9+Safari4+Chrome1+

Opera10+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS3.2+Chrome

Android18+WebView Android37+Samsung

Internet1.0+Opera Android10.1+

*oninvalid*



### [GlobalEventHandlers/oninvalid](#)

Support in all current engines.

## [invalid](#)

Firefox9+Safari5+Chrome4+

Opera12.1+Edge79+

Edge (Legacy)13+Internet ExplorerNo

Firefox Android9+Safari iOS4+Chrome

Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

*onkeydown*



### [GlobalEventHandlers/onkeydown](#)

Support in all current engines.

## [keydown](#)

Firefox9+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android9+Safari iOS1+Chrome

Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

*onkeypress*

## [keypress](#)

*onkeyup*



### [GlobalEventHandlers/onkeyup](#)

## [keyup](#)

Support in all current engines.

## [Event handler](#)

Firefox9+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android9+Safari iOS1+Chrome

Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

*onloadeddata*

✓MDN

## [Event handler event type](#)

### [loadeddata](#)

Firefox9+Safari9+Chrome32+

Opera19+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS9+Chrome

Android32+WebView Android4.4.3+Samsung

Internet2.0+Opera Android19+

*onloadedmetadata*

✓MDN

### [loadedmetadata](#)

GlobalEventHandlers/onloadedmetadata

Support in all current engines.

Firefox9+Safari9+Chrome32+

Opera19+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS9+Chrome

Android32+WebView Android4.4.3+Samsung

Internet2.0+Opera Android19+

*onloadstart*

✓MDN

GlobalEventHandlers/onloadstart

Support in all current engines.

### [loadstart](#)

Firefox9+Safari9+Chrome32+

Opera19+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS9+Chrome

## [Event handler](#)

Android32+WebView Android4.4.3+Samsung  
Internet2.0+Opera Android19+

*onmousedown*



[GlobalEventHandlers/onmousedown](#)

Support in all current engines.

## [Event handler event type](#)

[mousedown](#)

Firefox9+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer4+

Firefox Android9+Safari iOS1+Chrome  
Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

*onmouseenter*



[GlobalEventHandlers/onmouseenter](#)

Support in all current engines.

[mouseenter](#)

Firefox10+Safari7+Chrome30+

Opera17+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android10+Safari iOS7+Chrome  
Android30+WebView Android4.4+Samsung  
Internet2.0+Opera Android18+

*onmouseleave*



[GlobalEventHandlers/onmouseleave](#)

Support in all current engines.

[mouseleave](#)

Firefox10+Safari7+Chrome30+

Opera17+Edge79+

Edge (Legacy)12+Internet Explorer5.5+

Firefox Android10+Safari iOS7+Chrome  
Android30+WebView Android4.4+Samsung  
Internet2.0+Opera Android18+

*onmousemove*



[mousemove](#)

## [Event handler](#)

## [Event handler event type](#)

### [GlobalEventHandlers/onmousemove](#)

Support in all current engines.

Firefox 9+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 9+ Safari iOS 1+ Chrome

Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

*onmouseout*



### [GlobalEventHandlers/onmouseout](#)

Support in all current engines.

[mouseout](#)

Firefox 9+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 9+ Safari iOS 1+ Chrome

Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

*onmouseover*



### [GlobalEventHandlers/onmouseover](#)

Support in all current engines.

[mouseover](#)

Firefox 9+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 9+ Safari iOS 1+ Chrome

Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

*onmouseup*



[mouseup](#)

### [GlobalEventHandlers/onmouseup](#)

## [Event handler](#)

Support in all current engines.

Firefox 9+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 9+ Safari iOS 1+ Chrome

Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 12.1+

*onpause*



## [GlobalEventHandlers/onpause](#)

Support in all current engines.

[pause](#)

Firefox 9+ Safari 9+ Chrome 32+

Opera 19+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 9+ Chrome

Android 32+ WebView Android 4.4.3+ Samsung

Internet 2.0+ Opera Android 19+

*onplay*



## [GlobalEventHandlers/onplay](#)

Support in all current engines.

[play](#)

Firefox 9+ Safari 9+ Chrome 32+

Opera 19+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 9+ Chrome

Android 32+ WebView Android 4.4.3+ Samsung

Internet 2.0+ Opera Android 19+

*onplaying*



## [GlobalEventHandlers/onplaying](#)

[playing](#)

Support in all current engines.

Firefox 9+ Safari 9+ Chrome 32+

## [Event handler event type](#)

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
Opera19+Edge79+	
Edge (Legacy)12+Internet Explorer9+	
Firefox Android9+Safari iOS9+Chrome	
Android32+WebView Android4.4.3+Samsung	
Internet2.0+Opera Android19+	
<i>onprogress</i>	<a href="#">progress</a>
<i>onratechange</i>	<a href="#">ratechange</a>
<i>onreset</i>	
✓MDN	

## [GlobalEventHandlers/onreset](#)

Support in all current engines.

[reset](#)

Firefox9+Safari1+Chrome1+	
Opera12.1+Edge79+	
Edge (Legacy)12+Internet Explorer9+	
Firefox Android9+Safari iOS1+Chrome	
Android18+WebView Android1+Samsung	
Internet1.0+Opera Android12.1+	
<i>onsecuritypolicyviolation</i>	

MDN

## [GlobalEventHandlers/onsecuritypolicyviolation](#)

Firefox93+Safariipreview+ChromeNo	
OperaNoEdgeNo	
Edge (Legacy)NoInternet ExplorerNo	
Firefox Android93+Safari iOSNoChrome	
AndroidNoWebView AndroidNoSamsung InternetNoOpera	
AndroidNo	

<i>onseeked</i>	<a href="#">seeked</a>
<i>onseeking</i>	<a href="#">seeking</a>
<i>onselect</i>	

✓MDN

## [GlobalEventHandlers/onselect](#)

[select](#)

Support in all current engines.

Firefox9+Safari1+Chrome1+	
Opera12.1+Edge79+	

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
Edge (Legacy)12+Internet Explorer9+	
Firefox Android9+Safari iOS1+Chrome	
Android18+WebView Android1+Samsung	
Internet1.0+Opera Android12.1+	
<i>onslotchange</i>	
MDN	

## [GlobalEventHandlers/onslotchange](#)

Firefox93+Safariipreview+ChromeNo [slotchange](#)

OperaNoEdgeNo

Edge (Legacy)NoInternet ExplorerNo

Firefox Android93+Safari iOSNoChrome  
AndroidNoWebView AndroidNoSamsung InternetNoOpera

AndroidNo

*onstalled*

[stalled](#)

*onsubmit*

✓MDN

## [GlobalEventHandlers/onsubmit](#)

Support in all current engines.

[submit](#)

Firefox9+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS1+Chrome  
Android18+WebView Android1+Samsung  
Internet1.0+Opera Android12.1+

*onsuspend*

[suspend](#)

*ontimeupdate*

[timeupdate](#)

*ontoggle*

[toggle](#)

*onvolumechange*

[volumechange](#)

*onwaiting*

[waiting](#)

*onwebkitanimationend*

[webkitAnimationEnd](#)

*onwebkitanimationiteration*

[webkitAnimationIteration](#)

*onwebkitanimationstart*

[webkitAnimationStart](#)

*onwebkittransitionend*

[webkitTransitionEnd](#)

*onwheel*

[wheel](#)

✓MDN

## [Event handler](#)

## [Event handler event type](#)

### [GlobalEventHandlers/onwheel](#)

Support in all current engines.

Firefox 17+ Safari 7+ Chrome 31+

Opera 18+ Edge 79+

Edge (Legacy) 12+ Internet Explorer No

Firefox Android 17+ Safari iOS 7+ Chrome

Android 31+ WebView Android 4.4.3+ Samsung

Internet 2.0+ Opera Android 18+

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported by all [HTML elements](#) other than [body](#) and [frameset](#) elements, as both [event handler content attributes](#) and [event handler IDL attributes](#); that must be supported by all [Document](#) objects, as [event handler IDL attributes](#); and that must be supported by all [Window](#) objects, as [event handler IDL attributes](#) on the [Window](#) objects themselves, and with corresponding [event handler content attributes](#) and [event handler IDL attributes](#) exposed on all [body](#) and [frameset](#) elements that are owned by that [Window](#) object's associated [Document](#):

## [Event handler](#)

## [Event handler event type](#)

### *onblur*



### [GlobalEventHandlers/onblur](#)

Support in all current engines.

[blur](#)

Firefox 9+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 1+ Chrome Android 18+ WebView

Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

### *onerror*



### [GlobalEventHandlers/onerror](#)

[error](#)

Support in all current engines.

Firefox 1+ Safari 6+ Chrome 10+

Opera 11.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

## [Event handler](#)

## [Event handler event type](#)

Firefox Android4+Safari iOS6+Chrome Android18+WebView  
Android37+Samsung Internet1.0+Opera Android12+

*onfocus*

✓MDN

[GlobalEventHandlers/onfocus](#)

Support in all current engines.

[focus](#)

Firefox9+Safari1+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS1+Chrome Android18+WebView

Android1+Samsung Internet1.0+Opera Android12.1+

*onload*

✓MDN

[GlobalEventHandlers/onload](#)

Support in all current engines.

[load](#)

Firefox1+Safari3+Chrome1+

Opera9+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android4+Safari iOS1+Chrome Android18+WebView

Android1+Samsung Internet1.0+Opera Android10.1+

*onresize*

✓MDN

[GlobalEventHandlers/onresize](#)

Support in all current engines.

[resize](#)

Firefox38+Safari10.1+Chrome34+

Opera21+Edge79+

Edge (Legacy)NoInternet Explorer 4+

Firefox Android38+Safari iOS10.3+Chrome Android34+WebView

Android37+Samsung Internet2.0+Opera Android21+

*onscroll*

✓MDN

[scroll](#)

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
-------------------------------	------------------------------------------

## [GlobalEventHandlers/onscroll](#)

Support in all current engines.

Firefox9+Safari1.3+Chrome1+

Opera12.1+Edge79+

Edge (Legacy)12+Internet Explorer9+

Firefox Android9+Safari iOS1+Chrome Android18+WebView

Android1+Samsung Internet1.0+Opera Android12.1+

We call the [set](#) of the [names](#) of the [event handlers](#) listed in the first column of this table the *Window-reflecting body element event handler set*.

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported by [Window](#) objects, as [event handler IDL attributes](#) on the [Window](#) objects themselves, and with corresponding [event handler content attributes](#) and [event handler IDL attributes](#) exposed on all [body](#) and [frameset](#) elements that are owned by that [Window](#) object's [associated Document](#):

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
-------------------------------	------------------------------------------

### *onafterprint*



## [WindowEventHandlers/onafterprint](#)

Support in all current engines.

[afterprint](#)

Firefox6+Safari13+Chrome63+

Opera50+Edge79+

Edge (Legacy)12+Internet Explorer6+

Firefox Android?Safari iOS13+Chrome Android63+WebView

Android63+Samsung Internet8.0+Opera Android46+

### *onbeforeprint*



## [WindowEventHandlers/onbeforeprint](#)

[beforeprint](#)

Support in all current engines.

Firefox6+Safari13+Chrome63+

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
Opera50+Edge79+	
Edge (Legacy)12+Internet Explorer6+	
Firefox Android?Safari iOS13+Chrome Android63+WebView Android63+Samsung Internet8.0+Opera Android46+	
<i>onbeforeunload</i>	
 MDN	
<a href="#">WindowEventHandlers/onbeforeunload</a>	
Support in all current engines.	<a href="#">beforeunload</a>
Firefox1+Safari3+Chrome1+	
Opera12+Edge79+	
Edge (Legacy)12+Internet Explorer4+	
Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12+	
<i>onhashchange</i>	
 MDN	
<a href="#">WindowEventHandlers/onhashchange</a>	
Support in all current engines.	<a href="#">hashchange</a>
Firefox3.6+Safari5+Chrome5+	
Opera10+Edge79+	
Edge (Legacy)12+Internet Explorer8+	
Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android10.1+	
<i>onlanguagechange</i>	
 MDN	
<a href="#">WindowEventHandlers/onlanguagechange</a>	
Support in all current engines.	<a href="#">languagechange</a>
Firefox32+Safari10.1+Chrome37+	
Opera24+Edge79+	
Edge (Legacy)NoInternet ExplorerNo	
Firefox Android4+Safari iOS10.3+Chrome Android37+WebView Android37+Samsung Internet4.0+Opera Android24+	
<i>onmessage</i>	<a href="#">message</a>

## [Event handler](#)

## [Event handler event type](#)

✓MDN

### [WindowEventHandlers/onmessage](#)

Support in all current engines.

Firefox 9+ Safari 4+ Chrome 60+

Opera 47+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 8+

Firefox Android 9+ Safari iOS 4+ Chrome Android 60+ WebView  
Android 60+ Samsung Internet 8.0+ Opera Android 44+

*onmessageerror*

MDN

### [WindowEventHandlers/onmessageerror](#)

Firefox 57+ Safari No Chrome 60+

[messageerror](#)

Opera 47+ Edge 79+

Edge (Legacy) 18 Internet Explorer No

Firefox Android 57+ Safari iOS No Chrome Android 60+ WebView  
Android 60+ Samsung Internet 8.0+ Opera Android 44+

*onoffline*

[offline](#)

*ononline*

[online](#)

*onpagehide*

[pagehide](#)

*onpageshow*

[pageshow](#)

*onpopstate*

✓MDN

### [WindowEventHandlers/onpopstate](#)

Support in all current engines.

[popstate](#)

Firefox 4+ Safari 5+ Chrome 5+

Opera 11.5+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 4.2+ Chrome Android 18+ WebView  
Android 37+ Samsung Internet 1.0+ Opera Android 11.5+

*onrejectionhandled*

[rejectionhandled](#)

✓MDN

## [Event handler](#)

## [Event handler event type](#)

### [WindowEventHandlers/onrejectionhandled](#)

Support in all current engines.

Firefox 69+ Safari 11+ Chrome 49+

Opera 36+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 68+ Safari iOS 11.3+ Chrome Android 49+ WebView

Android 49+ Samsung Internet 5.0+ Opera Android No

*onstorage*



### [WindowEventHandlers/onstorage](#)

Support in all current engines.

[storage](#)

Firefox 45+ Safari 4+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 15+ Internet Explorer 9+

Firefox Android 45+ Safari iOS 4+ Chrome Android 18+ WebView

Android 37+ Samsung Internet 1.0+ Opera Android 14+

*onunhandledrejection*



### [WindowEventHandlers/onunhandledrejection](#)

Support in all current engines.

[unhandledrejection](#)

Firefox 69+ Safari 11+ Chrome 49+

Opera 36+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 68+ Safari iOS 11.3+ Chrome Android 49+ WebView

Android 49+ Samsung Internet 5.0+ Opera Android No

*onunload*



### [WindowEventHandlers/onunload](#)

[unload](#)

Support in all current engines.

Firefox 9+ Safari 4+ Chrome 1+

<u>Event handler</u>	<u>Event handler event type</u>
Opera 12.1+ Edge 79+	
Edge (Legacy) 12+ Internet Explorer 6+	
Firefox Android 9+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+	

This list of [event handlers](#) is reified as [event handler IDL attributes](#) through the [WindowEventHandlers](#) interface mixin.

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported by all [HTML elements](#), as both [event handler content attributes](#) and [event handler IDL attributes](#); and that must be supported by all [Document](#) objects, as [event handler IDL attributes](#):

#### Event handler Event handler event type

<i>oncut</i>	<a href="#">cut</a>
<i>oncopy</i>	<a href="#">copy</a>
<i>onpaste</i>	<a href="#">paste</a>

This list of [event handlers](#) is reified as [event handler IDL attributes](#) through the [DocumentAndElementEventHandlers](#) interface mixin.

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported on [Document](#) objects as [event handler IDL attributes](#):

<u>Event handler</u>	<u>Event handler event type</u>
<i>onreadystatechange</i>	<a href="#">readystatechange</a>
<i>onvisibilitychange</i>	<a href="#">visibilitychange</a>

8.1.7.2.1 IDL definitions



#### [GlobalEventHandlers](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet1.0+ Opera Android Yes

## WindowEventHandlers

Support in all current engines.

Firefox1+Safari3+Chrome1+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer4+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android12.1+

```
interface mixin GlobalEventHandlers {
 attribute EventHandler onabort;
 attribute EventHandler onauxclick;
 attribute EventHandler onblur;
 attribute EventHandler oncancel;
 attribute EventHandler oncanplay;
 attribute EventHandler oncanplaythrough;
 attribute EventHandler onchange;
 attribute EventHandler onclick;
 attribute EventHandler onclose;
 attribute EventHandler oncontextlost;
 attribute EventHandler oncontextmenu;
 attribute EventHandler oncontextrestored;
 attribute EventHandler oncuechange;
 attribute EventHandler ondblclick;
 attribute EventHandler ondrag;
 attribute EventHandler ondragend;
 attribute EventHandler ondragenter;
 attribute EventHandler ondragleave;
 attribute EventHandler ondragover;
 attribute EventHandler ondragstart;
 attribute EventHandler ondrop;
 attribute EventHandler ondurationchange;
 attribute EventHandler onemptied;
 attribute EventHandler onended;
 attribute OnErrorEventHandler onerror;
 attribute EventHandler onfocus;
 attribute EventHandler onformdata;
 attribute EventHandler oninput;
 attribute EventHandler oninvalid;
 attribute EventHandler onkeydown;
 attribute EventHandler onkeypress;
 attribute EventHandler onkeyup;
 attribute EventHandler onload;
 attribute EventHandler onloadeddata;
```

```
attribute EventHandler onloadedmetadata;
attribute EventHandler onloadstart;
attribute EventHandler onmousedown;
[LegacyLenientThis] attribute EventHandler onmouseenter;
[LegacyLenientThis] attribute EventHandler onmouseleave;
attribute EventHandler onmousemove;
attribute EventHandler onmouseout;
attribute EventHandler onmouseover;
attribute EventHandler onmouseup;
attribute EventHandler onpause;
attribute EventHandler onplay;
attribute EventHandler onplaying;
attribute EventHandler onprogress;
attribute EventHandler onratechange;
attribute EventHandler onreset;
attribute EventHandler onresize;
attribute EventHandler onscroll;
attribute EventHandler onsecuritypolicyviolation;
attribute EventHandler onseeked;
attribute EventHandler onseeking;
attribute EventHandler onselect;
attribute EventHandler onslotchange;
attribute EventHandler onstalled;
attribute EventHandler onsubmit;
attribute EventHandler onsuspend;
attribute EventHandler ontimeupdate;
attribute EventHandler ontoggle;
attribute EventHandler onvolumechange;
attribute EventHandler onwaiting;
attribute EventHandler onwebkitanimationend;
attribute EventHandler onwebkitanimationiteration;
attribute EventHandler onwebkitanimationstart;
attribute EventHandler onwebkittransitionend;
attribute EventHandler onwheel;
};

interface mixin WindowEventHandlers {
attribute EventHandler onafterprint;
attribute EventHandler onbeforeprint;
attribute OnBeforeUnloadEventHandler onbeforeunload;
attribute EventHandler onhashchange;
attribute EventHandler onlanguagechange;
attribute EventHandler onmessage;
attribute EventHandler onmessageerror;
attribute EventHandler onoffline;
attribute EventHandler ononline;
attribute EventHandler onpagehide;
```

```

attribute EventHandler onpageshow;
attribute EventHandler onpopstate;
attribute EventHandler onrejectionhandled;
attribute EventHandler onstorage;
attribute EventHandler onunhandledrejection;
attribute EventHandler onunload;
};

interface mixin DocumentAndElementEventHandlers {
 attribute EventHandler oncopy;
 attribute EventHandler oncut;
 attribute EventHandler onpaste;
};

```

#### 8.1.7.3 Event firing

Certain operations and methods are defined as firing events on elements. For example, the [click\(\)](#) method on the [HTMLElement](#) interface is defined as firing a [click](#) event on the element. [\[UIEVENTS\]](#)

*Firing a synthetic pointer event named e at target, with an optional not trusted flag, means running these steps:*

1. Let event be the result of [creating an event](#) using [PointerEvent](#).
2. Initialize event's [type](#) attribute to e.
3. Initialize event's [bubbles](#) and [cancelable](#) attributes to true.
4. Set event's [composed flag](#).
5. If the *not trusted flag* is set, initialize event's [isTrusted](#) attribute to false.
6. Initialize event's [ctrlKey](#), [shiftKey](#), [altKey](#), and [metaKey](#) attributes according to the current state of the key input device, if any (false for any keys that are not available).
7. Initialize event's [view](#) attribute to target's [node document](#)'s [Window](#) object, if any, and null otherwise.
8. event's [getModifierState\( \)](#) method is to return values appropriately describing the current state of the key input device.
9. Return the result of [dispatching](#) event at target.

*Firing a [click](#) event at target means [firing a synthetic pointer event named click](#) at target.*

## 8.2 The [WindowOrWorkerGlobalScope](#) mixin

The [WindowOrWorkerGlobalScope](#) mixin is for use of APIs that are to be exposed on [Window](#) and [WorkerGlobalScope](#) objects.

Other standards are encouraged to further extend it using `partial interface mixin WindowOrWorkerGlobalScope { ... }`; along with an appropriate reference.

```
typedef (DOMString or Function) TimerHandler;

interface mixin WindowOrWorkerGlobalScope {
 [Replaceable] readonly attribute USVString origin;
 readonly attribute boolean isSecureContext;
 readonly attribute boolean crossOriginIsolated;

 undefined reportError(any e);

 // base64 utility methods
 DOMString btoa(DOMString data);
 ByteString atob(DOMString data);

 // timers
 long setTimeout(TimerHandler handler, optional long timeout = 0, any... args);
 undefined clearTimeout(optional long id = 0);
 long setInterval(TimerHandler handler, optional long timeout = 0, any... args);
 undefined clearInterval(optional long id = 0);

 // microtask queuing
 undefined queueMicrotask(VoidFunction callback);

 // ImageBitmap
 Promise<ImageBitmap> createImageBitmap(ImageBitmapSource image, optional ImageBitmapSource defaultImage);
 Promise<ImageBitmap> createImageBitmap(ImageBitmapSource image, long sx, long sy);

 // structured cloning
 any structuredClone(any value, optional StructuredSerializeOptions options);
};

Window includes WindowOrWorkerGlobalScope;
WorkerGlobalScope includes WindowOrWorkerGlobalScope;

self.isSecureContext
```



[isSecureContext](#)

Support in all current engines.

Firefox49+Safari11.1+Chrome47+

---

Opera34+Edge79+

---

Edge (Legacy)15+Internet ExplorerNo

---

Firefox Android49+Safari iOS11.3+Chrome Android47+WebView Android47+Samsung Internet5.0+Opera Android34+

Returns whether or not this global object represents a [secure context](#). [SECURE-CONTEXTS]

## **[self.origin](#)**

✓MDN

### [origin](#)

Support in all current engines.

Firefox54+Safari11+Chrome59+

---

Opera46+Edge79+

---

Edge (Legacy)18Internet ExplorerNo

---

Firefox Android54+Safari iOS11+Chrome Android59+WebView Android59+Samsung Internet7.0+Opera Android43+

Returns the global object's [origin](#), serialized as string.

## **[self.crossOriginIsolated](#)**

MDN

### [crossOriginIsolated](#)

Firefox72+SafariNoChrome87+

---

Opera73+Edge87+

---

Edge (Legacy)NoInternet ExplorerNo

---

Firefox AndroidNoSafari iOSNoChrome Android87+WebView AndroidNoSamsung Internet14.0+Opera AndroidNo

Returns whether scripts running in this global are allowed to use APIs that require cross-origin isolation. This depends on the '[Cross-Origin-Opener-Policy](#)' and '[Cross-Origin-Embedder-Policy](#)' HTTP response headers and the "[cross-origin-isolated](#)" feature.

Developers are strongly encouraged to use `self.origin` over `location.origin`. The former returns the [origin](#) of the environment, the latter of the URL of the environment. Imagine the following script executing in a document on <https://stargate.example/>:

```
var frame = document.createElement("iframe")
```

```
frame.onload = function() {
 var frameWin = frame.contentWindow
 console.log(frameWin.location.origin) // "null"
 console.log(frameWin.origin) // "https://stargate.example"
}
document.body.appendChild(frame)
```

`self.origin` is a more reliable security indicator.

The `isSecureContext` getter steps are to return true if `this`'s [relevant settings object](#) is a [secure context](#), or false otherwise.

The `origin` getter steps are to return `this`'s [relevant settings object](#)'s [origin, serialized](#).

The `crossOriginIsolated` getter steps are to return `this`'s [relevant settings object](#)'s [cross-origin isolated capability](#).

## 8.3 Base64 utility methods

The [`atob\(\)`](#) and [`btoa\(\)`](#) methods allow developers to transform content to and from the base64 encoding.

In these APIs, for mnemonic purposes, the "b" can be considered to stand for "binary", and the "a" for "ASCII". In practice, though, for primarily historical reasons, both the input and output of these functions are Unicode strings.

**result = self.[btoa\(data\)](#)**

✓MDN

[btoa](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 4+

---

Opera 10.5+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

Takes the input data, in the form of a Unicode string containing only characters in the range U+0000 to U+00FF, each representing a binary byte with values 0x00 to 0xFF respectively, and converts it to its base64 representation, which it returns.

Throws an ["InvalidCharacterError" DOMException](#) exception if the input string contains any out-of-range characters.

```
result = self.atob(data)
```



## [atob](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 4+

---

Opera 10.5+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

Takes the input data, in the form of a Unicode string containing base64-encoded binary data, decodes it, and returns a string consisting of characters in the range U+0000 to U+00FF, each representing a binary byte with values 0x00 to 0xFF respectively, corresponding to that binary data.

Throws an ["InvalidCharacterError" DOMException](#) if the input string is not valid base64 data.

The **btoa(data)** method must throw an ["InvalidCharacterError" DOMException](#) if *data* contains any character whose code point is greater than U+00FF. Otherwise, the user agent must convert *data* to a byte sequence whose *n*th byte is the eight-bit representation of the *n*th code point of *data*, and then must apply [forgiving-base64 encode](#) to that byte sequence and return the result.

The **atob(data)** method steps are:

1. Let *decodedData* be the result of running [forgiving-base64 decode](#) on *data*.
2. If *decodedData* is failure, then throw an ["InvalidCharacterError" DOMException](#).
3. Return *decodedData*.

## 8.4 Dynamic markup insertion

APIs for dynamically inserting markup into the document interact with the parser, and thus their behavior varies depending on whether they are used with [HTML documents](#) (and the [HTML parser](#)) or [XML documents](#) (and the [XML parser](#)).

[Document](#) objects have a *throw-on-dynamic-markup-insertion counter*, which is used in conjunction with the [create an element for the token](#) algorithm to prevent [custom element constructors](#) from being able to use [document.open\(\)](#), [document.close\(\)](#), and [document.write\(\)](#) when they are invoked by the parser. Initially, the counter must be set to

zero.

#### 8.4.1 Opening the input stream

**`document = document.open()`**

✓MDN

[Document/open](#)

Support in all current engines.

Firefox 1+ Safari 11+ Chrome 64+

---

Opera 51+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 11+ Chrome Android 64+ WebView Android 64+ Samsung Internet 9.0+ Opera Android 47+

Causes the [Document](#) to be replaced in-place, as if it was a new [Document](#) object, but reusing the previous object, which is then returned.

The resulting [Document](#) has an HTML parser associated with it, which can be given data to parse using [document.write\(\)](#).

The method has no effect if the [Document](#) is still being parsed.

Throws an "[InvalidStateError](#)" [DOMException](#) if the [Document](#) is an [XML document](#).

Throws an "[InvalidStateError](#)" [DOMException](#) if the parser is currently executing a custom element constructor.

**`window = document.open(url, name, features)`**

Works like the [window.open\(\)](#) method.

[Document](#) objects have an *active parser was aborted* boolean, which is used to prevent scripts from invoking the [document.open\(\)](#) and [document.write\(\)](#) methods (directly or indirectly) after the document's [active parser](#) has been aborted. It is initially false.

The *document open* steps, given a *document*, are as follows:

1. If *document* is an [XML document](#), then throw an "[InvalidStateError](#)" [DOMException](#) exception.
2. If *document*'s [throw-on-dynamic-markup-insertion counter](#) is greater than 0, then throw an "[InvalidStateError](#)" [DOMException](#).

3. Let *entryDocument* be the [entry global object](#)'s [associated Document](#).
4. If *document*'s [origin](#) is not [same origin](#) to *entryDocument*'s [origin](#), then throw a "[SecurityError](#)" [DOMException](#).
5. If *document* has an [active parser](#) whose [script nesting level](#) is greater than 0, then return *document*.

This basically causes [document.open\(\)](#) to be ignored when it's called in an inline script found during parsing, while still letting it have an effect when called from a non-parser task such as a timer callback or event handler.

6. Similarly, if *document*'s [unload counter](#) is greater than 0, then return *document*.

This basically causes [document.open\(\)](#) to be ignored when it's called from a [beforeunload](#), [pagehide](#), or [unload](#) event handler while the [Document](#) is being unloaded.

7. If *document*'s [active parser was aborted](#) is true, then return *document*.

This notably causes [document.open\(\)](#) to be ignored if it is called after a [navigation](#) has started, but only during the initial parse. See [issue #4723](#) for more background.

8. If *document*'s [browsing context](#) is non-null and there is an existing attempt to [navigate](#) *document*'s [browsing context](#), then [stop document loading](#) given *document*.

[Issue #3447](#) looks into the distinction between an ongoing instance of the [navigate](#) algorithm versus tasks to [navigate](#) that are still queued. For the purpose of implementing this step, both an ongoing instance of the [navigate](#) algorithm and tasks queued to [navigate](#) should be counted towards "an existing attempt to [navigate](#)," at least until that issue is resolved.

9. For each [shadow-including inclusive descendant](#) *node* of *document*, [erase all event listeners and handlers](#) given *node*.
10. If *document* is the [associated Document](#) of *document*'s [relevant global object](#), then [erase all event listeners and handlers](#) given *document*'s [relevant global object](#).
11. [Replace all](#) with null within *document*, without firing any mutation events.
12. If *document* is [fully active](#), then:

1. Let *newURL* be a copy of *entryDocument*'s [URL](#).
2. If *entryDocument* is not *document*, then set *newURL*'s [fragment](#) to null.
3. Run the [URL and history update steps](#) with *document* and *newURL*.

13. Set *document*'s [is initial about:blank](#) to false.
14. If *document*'s [iframe load in progress](#) flag is set, then set *document*'s [mute iframe load](#) flag.
15. Set *document* to [no-quirks mode](#).
16. Create a new [HTML parser](#) and associate it with *document*. This is a *script-created parser* (meaning that it can be closed by the [document.open\(\)](#) and [document.close\(\)](#) methods, and that the tokenizer will wait for an explicit call to [document.close\(\)](#) before emitting an end-of-file token). The encoding [confidence](#) is *irrelevant*.
17. Set the [insertion point](#) to point at just before the end of the [input stream](#) (which at this point will be empty).
18. [Update the current document readiness](#) of *document* to "loading".

This causes a [readystatechange](#) event to fire, but the event is actually unobservable to author code, because of the previous step which [erased all event listeners and handlers](#) that could observe it.

19. Return *document*.

The [document open steps](#) do not affect whether a [Document](#) is [ready for post-load tasks](#) or [completely loaded](#).

The [`open\(unused1, unused2\)`](#) method must return the result of running the [document open steps](#) with [this](#).

The *unused1* and *unused2* arguments are ignored, but kept in the IDL to allow code that calls the function with one or two arguments to continue working. They are necessary due to Web IDL [overload resolution algorithm](#) rules, which would throw a [TypeError](#) exception for such calls had the arguments not been there. [whatwg/webidl issue #581](#) investigates changing the algorithm to allow for their removal. [\[WEBIDL\]](#)

The [`open\(url, name, features\)`](#) method must run these steps:

1. If [this](#) is not an [active document](#), then throw an "[InvalidAccessError](#)" [DOMException](#) exception.
2. Return the result of running the [window open steps](#) with *url*, *name*, and *features*.

#### 8.4.2 Closing the input stream

##### [document.close\(\)](#)



## Document/close

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 64+

---

Opera 51+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 11+ Chrome Android 64+ WebView Android 64+ Samsung Internet 9.0+ Opera Android 47+

Closes the input stream that was opened by the [document.open\(\)](#) method.

Throws an ["InvalidStateError" DOMException](#) if the [Document](#) is an [XML document](#).

Throws an ["InvalidStateError" DOMException](#) if the parser is currently executing a [custom element constructor](#).

The `close()` method must run the following steps:

1. If the [Document](#) object is an [XML document](#), then throw an ["InvalidStateError" DOMException](#).
2. If the [Document](#) object's [throw-on-dynamic-markup-insertion counter](#) is greater than zero, then throw an ["InvalidStateError" DOMException](#).
3. If there is no [script-created parser](#) associated with the document, then return.
4. Insert an [explicit "EOF" character](#) at the end of the parser's [input stream](#).
5. If there is a [pending parsing-blocking script](#), then return.
6. Run the tokenizer, processing resulting tokens as they are emitted, and stopping when the tokenizer reaches the [explicit "EOF" character](#) or [spins the event loop](#).

### 8.4.3 [document.write\(\)](#)

**[document.write\(...text\)](#)**

✓MDN

## Document/write

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy)12+Internet Explorer4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android10.1+

In general, adds the given string(s) to the [Document](#)'s input stream.

This method has very idiosyncratic behavior. In some cases, this method can affect the state of the [HTML parser](#) while the parser is running, resulting in a DOM that does not correspond to the source of the document (e.g. if the string written is the string "`<plaintext>`" or "`<! - ->`"). In other cases, the call can clear the current page first, as if [`document.open\(\)`](#) had been called. In yet more cases, the method is simply ignored, or throws an exception. User agents are [explicitly allowed to avoid executing script elements inserted via this method](#). And to make matters even worse, the exact behavior of this method can in some cases be dependent on network latency, which can lead to failures that are very hard to debug. For all these reasons, use of this method is strongly discouraged.

Throws an "[InvalidStateError](#)" [DOMException](#) when invoked on [XML documents](#).

Throws an "[InvalidStateError](#)" [DOMException](#) if the parser is currently executing a [custom element constructor](#).

[Document](#) objects have an *ignore-destructive-writes counter*, which is used in conjunction with the processing of [script](#) elements to prevent external scripts from being able to use [`document.write\(\)`](#) to blow away the document by implicitly calling [`document.open\(\)`](#). Initially, the counter must be set to zero.

The *document write steps*, given a [Document](#) object *document* and a string *input*, are as follows:

1. If *document* is an [XML document](#), then throw an "[InvalidStateError](#)" [DOMException](#).
2. If *document*'s [throw-on-dynamic-markup-insertion counter](#) is greater than 0, then throw an "[InvalidStateError](#)" [DOMException](#).
3. If *document*'s [active parser was aborted](#) is true, then return.
4. If the [insertion point](#) is undefined, then:
  1. If *document*'s [unload counter](#) is greater than 0 or *document*'s [ignore-destructive-writes counter](#) is greater than 0, then return.
  2. Run the [document open steps](#) with *document*.
5. Insert *input* into the [input stream](#) just before the [insertion point](#).

- If there is no [pending parsing-blocking script](#), have the [HTML parser](#) process *input*, one code point at a time, processing resulting tokens as they are emitted, and stopping when the tokenizer reaches the insertion point or when the processing of the tokenizer is aborted by the tree construction stage (this can happen if a [script](#) end tag token is emitted by the tokenizer).

If the [`document.write\(\)`](#) method was called from script executing inline (i.e. executing because the parser parsed a set of [script](#) tags), then this is a [reentrant invocation of the parser](#). If the [parser pause flag](#) is set, the tokenizer will abort immediately and no HTML will be parsed, per the tokenizer's [parser pause flag check](#).

The [`document.write\(...\)`](#) method steps are to run the [document write steps](#) with [this](#) and a string that is the concatenation of all arguments passed.

#### 8.4.4 [`document.writeln\(\)`](#)

##### [`document.writeln\(...text\)`](#)

✓MDN

[Document/writeln](#)

Support in all current engines.

Firefox 1+ Safari 11+ Chrome 64+

---

Opera 51+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 11+ Chrome Android 64+ WebView Android 64+ Samsung Internet 9.0+ Opera Android 47+

Adds the given string(s) to the [Document](#)'s input stream, followed by a newline character. If necessary, calls the [`open\(\)`](#) method implicitly first.

Throws an ["InvalidStateError" DOMException](#) when invoked on [XML documents](#).

Throws an ["InvalidStateError" DOMException](#) if the parser is currently executing a [custom element constructor](#).

The [`document.writeln\(...\)`](#) method steps are to run the [document write steps](#) with [this](#) and a string that is the concatenation of all arguments passed and U+000A LINE FEED.

#### 8.5 DOM parsing

✓MDN

[DOMParser](#)

Support in all current engines.

Firefox 1+ Safari 1.3+ Chrome 1+

---

Opera 8+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

---

Internet 1.0+ Opera Android 10.1+

The [DOMParser](#) interface allows authors to create new [Document](#) objects by parsing strings, as either HTML or XML.

**parser = new DOMParser()**

✓MDN

[DOMParser/DOMParser](#)

Support in all current engines.

Firefox 1+ Safari 1.3+ Chrome 1+

---

Opera 8+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

---

Internet 1.0+ Opera Android Yes

Constructs a new [DOMParser](#) object.

**document = parser.parseFromString(string, type)**

✓MDN

[DOMParser/parseFromString](#)

Support in all current engines.

Firefox 1+ Safari 1.3+ Chrome 1+

---

Opera 8+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

---

Internet 1.0+ Opera Android 10.1+

Parses *string* using either the HTML or XML parser, according to *type*, and returns the resulting [Document](#). *type* can be "[text/html](#)" (which will invoke the HTML parser), or any of "[text/xml](#)", "[application/xml](#)", "[application/xhtml+xml](#)", or "[image/svg+xml](#)" (which will invoke the XML parser).

For the XML parser, if *string* cannot be parsed, then the returned [Document](#) will contain

elements describing the resulting error.

Note that `script` elements are not evaluated during parsing, and the resulting document's `encoding` will always be [UTF-8](#).

Values other than the above for `type` will cause a [TypeError](#) exception to be thrown.

The design of [DOMParser](#), as a class that needs to be constructed and then have its `parseFromString()` method called, is an unfortunate historical artifact. If we were designing this functionality today it would be a standalone function.

```
[Exposed=Window]
interface DOMParser {
 constructor();
 [NewObject] Document parseFromString(DOMString string, DOMParserSupportedType);
}

enum DOMParserSupportedType {
 "text/html",
 "text/xml",
 "application/xml",
 "application/xhtml+xml",
 "image/svg+xml"
};
```

The `new DOMParser()` constructor steps are to do nothing.

The `parseFromString(string, type)` method steps are:

1. Let `document` be a new [Document](#), whose `content type` is `type` and `url` is this's [relevant global object](#)'s [associated Document](#)'s [URL](#).

The document's `encoding` will be left as its default, of [UTF-8](#). In particular, any XML declarations or `meta` elements found while parsing `string` will have no effect.

2. Switch on `type`:

**"text/html"**

1. Set `document`'s `type` to "html".
2. Create an [HTML parser](#) `parser`, associated with `document`.
3. Place `string` into the [input stream](#) for `parser`. The encoding `confidence` is *irrelevant*.

4. Start *parser* and let it run until it has consumed all the characters just inserted into the input stream.

This might mutate the document's [mode](#).

Since *document* does not have a [browsing context](#), [scripting is disabled](#).

*Otherwise*

1. Create an [XML parser](#) *parse*, associated with *document*, and with [XML scripting support disabled](#).
2. Parse *string* using *parser*.
3. If the previous step resulted in an XML well-formedness or XML namespace well-formedness error, then:
  1. Assert: *document* has no child nodes.
  2. Let *root* be the result of [creating an element](#) given *document*, "parsererror", and "<http://www.mozilla.org/newlayout/xml/parsererror.xml>".
  3. Optionally, add attributes or children to *root* to describe the nature of the parsing error.
  4. [Append](#) *root* to *document*.
3. Return *document*.

## 8.6 Timers

The [setTimeout\(\)](#) and [setInterval\(\)](#) methods allow authors to schedule timer-based callbacks.

**`id = self.setTimeout(handler [, timeout [, ...arguments] ])`**

✓MDN

## [setTimeout](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 4+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet 1.0+ Opera Android 10.1+

Schedules a timeout to run *handler* after *timeout* milliseconds. Any *arguments* are passed straight through to the *handler*.

**`id = self.setTimeout(code [, timeout ])`**

Schedules a timeout to compile and run *code* after *timeout* milliseconds.

**`self.clearTimeout(id)`**

✓MDN

## [clearTimeout](#)

Support in all current engines.

Firefox 1+ Safari 4+ Chrome 1+

Opera 4+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 10.1+

Cancels the timeout set with [setTimeout\(\)](#) or [setInterval\(\)](#) identified by *id*.

**`id = self.setInterval(handler [, timeout [, ...arguments] ])`**

✓MDN

## [setInterval](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 4+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Schedules a timeout to run *handler* every *timeout* milliseconds. Any *arguments* are passed straight through to the *handler*.

**`id = self.setInterval(code [, timeout ])`**

Schedules a timeout to compile and run *code* every *timeout* milliseconds.

**`self.clearInterval(id)`**

✓MDN

[clearInterval](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera4+Edge79+

Edge (Legacy)12+Internet Explorer4+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android10.1+

Cancels the timeout set with [setInterval\(\)](#) or [setTimeout\(\)](#) identified by *id*.

Timers can be nested; after five such nested timers, however, the interval is forced to be at least four milliseconds.

This API does not guarantee that timers will run exactly on schedule. Delays due to CPU load, other tasks, etc, are to be expected.

Objects that implement the [WindowOrWorkerGlobalScope](#) mixin have a *map of active timers*, which is a [map](#), initially empty. Each [key](#) in this map is an identifier for a timer, and each [value](#) is a [DOMHighResTimeStamp](#), representing the expiry time for that timer.

For entries put in the [map of active timers](#) by the [timer initialization steps](#), i.e., by [setTimeout\(\)](#) and [setInterval\(\)](#), the keys are numbers. For other specifications that use the [run steps after a timeout](#) algorithm, the identifier is a unique non-numeric value. Only the numeric-keyed timers are affected by [clearTimeout\(\)](#) and [clearInterval\(\)](#), but all timers contribute to [idle deadline computation](#), and are cleared when the relevant global is destroyed.

---

The [setTimeout\(handler, timeout, ...arguments\)](#) method steps are to return the result of running the [timer initialization steps](#) given [this](#), *handler*, *timeout*, *arguments*, and *false*.

The `setInterval(handler, timeout, ...arguments)` method steps are to return the result of running the [timer initialization steps](#) given `this`, `handler`, `timeout`, `arguments`, and true.

The `clearTimeout(id)` and `clearInterval(id)` method steps are to [remove this's map of active timers](#)[`id`].

Because [clearTimeout\(\)](#) and [clearInterval\(\)](#) clear entries from the same map, either method can be used to clear timers created by [setTimeout\(\)](#) or [setInterval\(\)](#).

---

The *timer initialization steps*, given a [WindowOrWorkerGlobalScope](#) `global`, a string or [Function](#) `handler`, a number `timeout`, a list `arguments`, a boolean `repeat`, and optionally (and only if `repeat` is true) a number `previousId`, are:

1. Let `thisArg` be `global` if that is a [WorkerGlobalScope](#) object; otherwise let `thisArg` be the [WindowProxy](#) that corresponds to `global`.
2. If `previousId` was given, let `id` be `previousId`; otherwise, let `id` be an [implementation-defined](#) integer that is greater than zero and does not already [exist](#) in `global`'s [map of active timers](#).
3. If the [surrounding agent](#)'s [event loop](#)'s [currently running task](#) is a task that was created by this algorithm, then let `nesting level` be the [task](#)'s [timer nesting level](#). Otherwise, let `nesting level` be zero.

The task's [timer nesting level](#) is used both for nested calls to [setTimeout\(\)](#), and for the repeating timers created by [setInterval\(\)](#). (Or, indeed, for any combination of the two.) In other words, it represents nested invocations of this algorithm, not of a particular method.

4. If `timeout` is less than 0, then set `timeout` to 0.
5. If `nesting level` is greater than 5, and `timeout` is less than 4, then set `timeout` to 4.
6. Let `callerRealm` be the [current Realm Record](#), and `calleeRealm` be `global`'s [relevant Realm](#).
7. Let `initiating script` be the [active script](#).
8. Assert: `initiating script` is not null, since this algorithm is always called from some script.
9. Let `task` be a [task](#) that runs the following substeps:
  1. If `id` does not [exist](#) in `global`'s [map of active timers](#), then abort these steps.
  2. If `handler` is a [Function](#), then [invoke handler](#) given `arguments` with the [callback this value](#) set to `thisArg`. If this throws an exception, catch it, and

[report the exception.](#)

3. Otherwise:

1. Assert: *handler* is a string.
2. Perform [HostEnsureCanCompileStrings](#)(*callerRealm*, *calleeRealm*). If this throws an exception, catch it, [report the exception](#), and abort these steps.
3. Let *settings object* be *global*'s [relevant settings object](#).
4. Let *base URL* be *initiating script*'s [base URL](#).
5. Assert: *base URL* is not null, as *initiating script* is a [classic script](#) or a [JavaScript module script](#).
6. Let *fetch options* be a [script fetch options](#) whose [cryptographic nonce](#) is *initiating script*'s [fetch options](#)'s [cryptographic nonce](#), [integrity metadata](#) is the empty string, [parser metadata](#) is "not-parser-inserted", [credentials mode](#) is *initiating script*'s [fetch options](#)'s [credentials mode](#), and [referrer policy](#) is *initiating script*'s [fetch options](#)'s [referrer policy](#).

The effect of these options ensures that the string compilation done by [setTimeout\(\)](#) and [setInterval\(\)](#) behaves equivalently to that done by [eval\(\)](#). That is, [module script](#) fetches via [import\(\)](#) will behave the same in both contexts.

7. Let *script* be the result of [creating a classic script](#) given *handler*, *settings object*, *base URL*, and *fetch options*.
8. [Run the classic script](#) *script*.

4. If *id* does not [exist](#) in *global*'s [map of active timers](#), then abort these steps.

It might have been removed via the author code in *handler* calling [clearTimeout\(\)](#) or [clearInterval\(\)](#).

5. If *repeat* is true, then perform the [timer initialization steps](#) again, given *global*, *handler*, *timeout*, *arguments*, true, and *id*.
10. Increment *nesting level* by one.
11. Set *task*'s *timer nesting level* to *nesting level*.
12. Let *completionStep* be an algorithm step which [queues a global task](#) on the *timer task source* given *global* to run *task*.

13. [Run steps after a timeout](#) given *global*, "setTimeout/setInterval", *timeout*, *completionStep*, and *id*.

Once the task has been processed, if *repeat* is false, it is safe to remove the entry for *id* from the [map of active timers](#) (there is no way for the entry's existence to be detected past this point, so it does not technically matter one way or the other).

14. Return *id*.

Argument conversion as defined by Web IDL (for example, invoking **toString()** methods on objects passed as the first argument) happens in the algorithms defined in Web IDL, before this algorithm is invoked.

So for example, the following rather silly code will result in the log containing "ONE TWO":

```
var log = '';
function logger(s) { log += s + ' ' }

setTimeout({ toString: function () {
 setTimeout("logger('ONE')", 100);
 return "logger('TWO')";
} }, 100);
```

To run tasks of several milliseconds back to back without any delay, while still yielding back to the browser to avoid starving the user interface (and to avoid the browser killing the script for hogging the CPU), simply queue the next timer before performing work:

```
function doExpensiveWork() {
 var done = false;
 // ...
 // this part of the function takes up to five milliseconds
 // set done to true if we're done
 // ...
 return done;
}

function rescheduleWork() {
 var id = setTimeout(rescheduleWork, 0); // preschedule next iteration
 if (doExpensiveWork())
 clearTimeout(id); // clear the timeout if we don't need it
}

function scheduleWork() {
 setTimeout(rescheduleWork, 0);
}

scheduleWork(); // queues a task to do lots of work
```

To run steps after a timeout, given a [WindowOrWorkerGlobalScope](#) *global*, a string *orderingIdentifier*, a number *milliseconds*, a set of steps *completionSteps*, and an optional value *timerKey*:

1. Assert: if *timerKey* is given, then the caller of this algorithm is the [timer initialization steps](#). (Other specifications must not pass *timerKey*.)
2. If *timerKey* is not given, then set it to a new unique non-numeric value.
3. Let *startTime* be the [current high resolution time](#).
4. Set *global*'s [map of active timers](#)[*timerKey*] to *startTime* plus *milliseconds*.
5. Run the following steps [in parallel](#):
  1. If *global* is a [Window](#) object, wait until *global*'s [associated Document](#) has been [fully active](#) for a further *milliseconds* milliseconds (not necessarily consecutively).Otherwise, *global* is a [WorkerGlobalScope](#) object; wait until *milliseconds* milliseconds have passed with the worker not suspended (not necessarily consecutively).
  2. Wait until any invocations of this algorithm that had the same *global* and *orderingIdentifier*, that started before this one, and whose *milliseconds* is equal to or less than this one's, have completed.
  3. Optionally, wait a further [implementation-defined](#) length of time.

This is intended to allow user agents to pad timeouts as needed to optimize the power usage of the device. For example, some processors have a low-power mode where the granularity of timers is reduced; on such platforms, user agents can slow timers down to fit this schedule instead of requiring the processor to use the more accurate mode with its associated higher power usage.

4. Perform *completionSteps*.

[Run steps after a timeout](#) is meant to be used by other specifications that want to execute developer-supplied code after a developer-supplied timeout, in a similar manner to [setTimeout\(\)](#). (Note, however, it does not have the nesting and clamping behavior of [setTimeout\(\)](#).) Such specifications can choose an *orderingIdentifier* to ensure ordering within their specification's timeouts, while not constraining ordering with respect to other specification's timeouts.

## 8.7 Microtask queuing

## [queueMicrotask](#)

Support in all current engines.

Firefox69+Safari12.1+Chrome71+

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Opera58+Edge79+

Edge (Legacy)NoInternet ExplorerNo

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Firefox Android79+Safari iOS12.2+Chrome Android71+WebView Android71+Samsung Internet10.0+Opera Android50+

### **[self.queueMicrotask\(callback\)](#)**

[Queues](#) a [microtask](#) to run the given *callback*.

The [queueMicrotask\(callback\)](#) method must [queue a microtask](#) to [invoke](#) *callback*, and if *callback* throws an exception, [report the exception](#).

The [queueMicrotask\(\)](#) method allows authors to schedule a callback on the [microtask queue](#). This allows their code to run once the [JavaScript execution context stack](#) is next empty, which happens once all currently executing synchronous JavaScript has run to completion. This doesn't yield control back to the [event loop](#), as would be the case when using, for example, [setTimeout\(f, 0\)](#).

Authors ought to be aware that scheduling a lot of microtasks has the same performance downsides as running a lot of synchronous code. Both will prevent the browser from doing its own work, such as rendering. In many cases, [requestAnimationFrame\(\)](#) or [requestIdleCallback\(\)](#) is a better choice. In particular, if the goal is to run code before the next rendering cycle, that is the purpose of [requestAnimationFrame\(\)](#).

As can be seen from the following examples, the best way of thinking about [queueMicrotask\(\)](#) is as a mechanism for rearranging synchronous code, effectively placing the queued code immediately after the currently executing synchronous JavaScript has run to completion.

The most common reason for using [queueMicrotask\(\)](#) is to create consistent ordering, even in the cases where information is available synchronously, without introducing undue delay.

For example, consider a custom element firing a `load` event, that also maintains an internal cache of previously-loaded data. A naïve implementation might look like:

```
MyElement.prototype.loadData = function (url) {
 if (this._cache[url]) {
 this._setData(this._cache[url]);
 this.dispatchEvent(new Event("load"));
 } else {
 fetch(url).then(res => res.arrayBuffer()).then(data => {
 this._cache[url] = data;
 this._setData(data);
```

```
 this.dispatchEvent(new Event("load"));
 });
}
};
```

This naïve implementation is problematic, however, in that it causes its users to experience inconsistent behavior. For example, code such as

```
element.addEventListener("load", () => console.log("loaded"));
console.log("1");
element.loadData();
console.log("2");
```

will sometimes log "1, 2, loaded" (if the data needs to be fetched), and sometimes log "1, loaded, 2" (if the data is already cached). Similarly, after the call to `loadData()`, it will be inconsistent whether or not the data is set on the element.

To get a consistent ordering, [queueMicrotask\(\)](#) can be used:

```
MyElement.prototype.loadData = function (url) {
 if (this._cache[url]) {
 queueMicrotask(() => {
 this._setData(this._cache[url]);
 this.dispatchEvent(new Event("load"));
 });
 } else {
 fetch(url).then(res => res.arrayBuffer()).then(data => {
 this._cache[url] = data;
 this._setData(data);
 this.dispatchEvent(new Event("load"));
 });
 }
};
```

By essentially rearranging the queued code to be after the [JavaScript execution context stack](#) empties, this ensures a consistent ordering and update of the element's state.

Another interesting use of [queueMicrotask\(\)](#) is to allow uncoordinated "batching" of work by multiple callers. For example, consider a library function that wants to send data somewhere as soon as possible, but doesn't want to make multiple network requests if doing so is easily avoidable. One way to balance this would be like so:

```
const queuedToSend = [];

function sendData(data) {
 queuedToSend.push(data);
```

```
if (queuedToSend.length === 1) {
 queueMicrotask(() => {
 const stringToSend = JSON.stringify(queuedToSend);
 queuedToSend.length = 0;

 fetch("/endpoint", stringToSend);
 });
}
}
```

With this architecture, multiple subsequent calls to `sendData()` within the currently executing synchronous JavaScript will be batched together into one `fetch()` call, but with no intervening event loop tasks preempting the fetch (as would have happened with similar code that instead used `setTimeout()`).

## 8.8 User prompts

### 8.8.1 Simple dialogs

**`window.alert(message)`**

✓MDN

[Window/alert](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Displays a modal alert with the given message, and waits for the user to dismiss it.

**`result = window.confirm(message)`**

✓MDN

[Window/confirm](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

---

Opera 3+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung

Internet1.0+Opera Android10.1+

Displays a modal OK/Cancel prompt with the given message, waits for the user to dismiss it, and returns true if the user clicks OK and false if the user clicks Cancel.

**`result = window.prompt(message [, default])`**

✓MDN

## [Window/prompt](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera3+Edge79+

---

Edge (Legacy)12+Internet Explorer4+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung

Internet1.0+Opera Android10.1+

Displays a modal text control prompt with the given message, waits for the user to dismiss it, and returns the value that the user entered. If the user cancels the prompt, then returns null instead. If the second argument is present, then the given value is used as a default.

Logic that depends on [tasks](#) or [microtasks](#), such as [media elements](#) loading their [media data](#), are stalled when these methods are invoked.

The `alert()` and `alert(message)` method steps are:

1. If we [cannot show simple dialogs](#) for [this](#), then return.
2. If the method was invoked with no arguments, then let `message` be the empty string; otherwise, let `message` be the method's first argument.
3. Set `message` to the result of [normalizing newlines](#) given `message`.
4. Set `message` to the result of [optionally truncating](#) `message`.
5. Show `message` to the user, treating U+000A LF as a line break.
6. Optionally, [pause](#) while waiting for the user to acknowledge the message.

This method is defined using two overloads, instead of using an optional argument, for historical reasons. The practical impact of this is that `alert(undefined)` is treated as `alert("undefined")`, but `alert()` is treated as `alert("")`.

The `confirm(message)` method steps are:

1. If we [cannot show simple dialogs](#) for [this](#), then return false.

2. Set *message* to the result of [normalizing newlines](#) given *message*.
3. Set *message* to the result of [optionally truncating](#) *message*.
4. Show *message* to the user, treating U+000A LF as a line break, and ask the user to respond with a positive or negative response.
5. [Pause](#) until the user responds either positively or negatively.
6. If the user responded positively, return true; otherwise, the user responded negatively: return false.

The *prompt(message, default)* method steps are:

1. If we [cannot show simple dialogs](#) for [this](#), then return null.
2. Set *message* to the result of [normalizing newlines](#) given *message*.
3. Set *message* to the result of [optionally truncating](#) *message*.
4. Set *default* to the result of [optionally truncating](#) *default*.
5. Show *message* to the user, treating U+000A LF as a line break, and ask the user to either respond with a string value or abort. The response must be defaulted to the value given by *default*.
6. [Pause](#) while waiting for the user's response.
7. If the user aborts, then return null; otherwise, return the string that the user responded with.

To *optionally truncate a simple dialog string s*, return either *s* itself or some string derived from *s* that is shorter. User agents should not provide UI for displaying the elided portion of *s*, as this makes it too easy for abusers to create dialogs of the form "Important security alert! Click 'Show More' for full details!".

For example, a user agent might want to only display the first 100 characters of a message. Or, a user agent might replace the middle of the string with "...". These types of modifications can be useful in limiting the abuse potential of unnaturally large, trustworthy-looking system dialogs.

We *cannot show simple dialogs* for a [Window](#) window when the following algorithm returns true:

1. If the [active sandboxing flag set](#) of *window*'s [associated Document](#) has the [sandboxed modals flag](#) set, then return true.
2. If *window*'s [relevant settings object](#)'s [origin](#) and *window*'s [relevant settings object](#)'s [top-](#)

[level origin](#) are not [same origin-domain](#), then return true.

3. If *window's relevant agent's event loop's termination nesting level* is nonzero, then optionally return true.
4. Optionally, return true. (For example, the user agent might give the user the option to ignore all modal dialogs, and would thus abort at this step whenever the method was invoked.)
5. Return false.

## 8.8.2 Printing



### [Window/print](#)

Support in all current engines.

Firefox 1+ Safari 1.1+ Chrome 1+

---

Opera 6+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 5+

---

Firefox Android No Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

### **[window.print\(\)](#)**

Prompts the user to print the page.

The *print()* method steps are:

1. Let *document* be [this's associated Document](#).
2. If *document* is not [fully active](#), then return.
3. If *document's unload counter* is greater than 0, then return.
4. If *document* is [ready for post-load tasks](#), then run the [printing steps](#) for *document*.
5. Otherwise, set *document's print when loaded* flag.

User agents should also run the [printing steps](#) whenever the user asks for the opportunity to [obtain a physical form](#) (e.g. printed copy), or the representation of a physical form (e.g. PDF copy), of a document.

The *printing steps* for a [Document](#) *document* are:

1. The user agent may display a message to the user or return (or both).

For instance, a kiosk browser could silently ignore any invocations of the [print\(\)](#) method.

For instance, a browser on a mobile device could detect that there are no printers in the vicinity and display a message saying so before continuing to offer a "save to PDF" option.

2. If the [active sandboxing flag set](#) of *document* has the [sandboxed modals flag](#) set, then return.

If the printing dialog is blocked by a [Document](#)'s sandbox, then neither the [beforeprint](#) nor [afterprint](#) events will be fired.

3. The user agent must [fire an event](#) named [beforeprint](#) at the [relevant global object](#) of *document*, as well as any [child browsing contexts](#) in it.

The [beforeprint](#) event can be used to annotate the printed copy, for instance adding the time at which the document was printed.

4. The user agent should offer the user the opportunity to [obtain a physical form](#) (or the representation of a physical form) of *document*. The user agent may wait for the user to either accept or decline before returning; if so, the user agent must [pause](#) while the method is waiting. Even if the user agent doesn't wait at this point, the user agent must use the state of the relevant documents as they are at this point in the algorithm if and when it eventually creates the alternate form.
5. The user agent must [fire an event](#) named [afterprint](#) at the [relevant global object](#) of *document*, as well as any [child browsing contexts](#) in it.

The [afterprint](#) event can be used to revert annotations added in the earlier event, as well as showing post-printing UI. For instance, if a page is walking the user through the steps of applying for a home loan, the script could automatically advance to the next step after having printed a form or other.

## 8.9 System state and capabilities

### 8.9.1 The [Navigator](#) object



#### [Navigator](#)

Support in all current engines.

Firefox 1+ | Safari 1+ | Chrome 1+

---

Opera 3+ | Edge 79+

---

Edge (Legacy)12+Internet Explorer4+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Instances of [Navigator](#) represent the identity and state of the user agent (the client). They also serve as a generic global under which various APIs are located in this and other specifications.

```
[Exposed=Window]
interface Navigator {
 // objects implementing this interface also implement the interfaces given
};

Navigator includes NavigatorID;
Navigator includes NavigatorLanguage;
Navigator includes NavigatorOnLine;
Navigator includes NavigatorContentUtils;
Navigator includes NavigatorCookies;
Navigator includes NavigatorPlugins;
Navigator includes NavigatorConcurrentHardware;
```

These interface mixins are defined separately so that [WorkerNavigator](#) can reuse parts of the [Navigator](#) interface.

Each [Window](#) has an *associated Navigator*, which is a [Navigator](#) object. Upon creation of the [Window](#) object, its *associated Navigator* must be set to a [new Navigator](#) object created in the [Window](#) object's [relevant Realm](#).



## [Window/navigator](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera3+Edge79+

---

Edge (Legacy)12+Internet Explorer4+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

The *navigator* and *clientInformation* getter steps are to return [this](#)'s [associated Navigator](#).

### 8.9.1.1 Client identification

```
interface mixin NavigatorID {
 readonly attribute DOMString appCodeName; // constant "Mozilla"
```

```
readonly attribute DOMString appName; // constant "Netscape"
readonly attribute DOMString appVersion;
readonly attribute DOMString platform;
readonly attribute DOMString product; // constant "Gecko"
[Exposed=Window] readonly attribute DOMString productSub;
readonly attribute DOMString userAgent;
[Exposed=Window] readonly attribute DOMString vendor;
[Exposed=Window] readonly attribute DOMString vendorSub; // constant ""
};
```

In certain cases, despite the best efforts of the entire industry, web browsers have bugs and limitations that web authors are forced to work around.

This section defines a collection of attributes that can be used to determine, from script, the kind of user agent in use, in order to work around these issues.

The user agent has a *navigator compatibility mode*, which is either *Chrome*, *Gecko*, or *WebKit*.

The navigator compatibility mode constrains the NavigatorID mixin to the combinations of attribute values and presence of taintEnabled() and oscpu that are known to be compatible with existing web content.

Client detection should always be limited to detecting known current versions; future versions and unknown versions should always be assumed to be fully compliant.

### **self.navigator.appCodeName**

Returns the string "Mozilla".

### **self.navigator.appName**

Returns the string "Netscape".

### **self.navigator.appVersion**

Returns the version of the browser.

### **self.navigator.platform**

Returns the name of the platform.

### **self.navigator.product**

Returns the string "Gecko".

### **window.navigator.productSub**

Returns either the string "20030107", or the string "20100101".

## [`self.navigator.userAgent`](#)

✓MDN

### [Navigator userAgent](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

## [`WorkerNavigator.userAgent`](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android Yes

Returns the complete 'User-Agent' header.

## [`window.navigator.vendor`](#)

✓MDN

### [Navigator/vendor](#)

Support in all current engines.

Firefox 1+ Safari 1+ Chrome 1+

Opera 15+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 11

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 14+

Returns either the empty string, the string "Apple Computer, Inc.", or the string "Google Inc.".

## [`window.navigator.vendorSub`](#)

Returns the empty string.

## ***appCodeName***

Must return the string "**Mozilla**".

## ***appName***

Must return the string "**Netscape**".

## ***appVersion***

Must return either the string "**4.0**" or a string representing the version of the browser in detail, e.g. "**1.0 (VMS; en-US) Mellblomenator/9000**".

## ***platform***

Must return either the empty string or a string representing the platform on which the browser is executing, e.g. "**MacIntel**", "**Win32**", "**FreeBSD i386**", "**WebTV OS**".

## ***product***

Must return the string "**Gecko**".

## ***productSub***

Must return the appropriate string from the following list:

If the [navigator compatibility mode](#) is *Chrome* or *WebKit*

The string "**20030107**".

If the [navigator compatibility mode](#) is *Gecko*

The string "**20100101**".

## ***userAgent***

Must return the [default 'User-Agent' value](#).

## ***vendor***

Must return the appropriate string from the following list:

If the [navigator compatibility mode](#) is *Chrome*

The string "**Google Inc.**".

If the [navigator compatibility mode](#) is *Gecko*

The empty string.

If the [navigator compatibility mode](#) is *WebKit*

The string "Apple Computer, Inc.".

## ***vendorSub***

Must return the empty string.

If the [navigator compatibility mode](#) is *Gecko*, then the user agent must also support the following partial interface:

```
partial interface mixin NavigatorID {
 [Exposed=Window] boolean taintEnabled\(\); // constant false
 [Exposed=Window] readonly attribute DOMString oscpu;
};
```

The *taintEnabled()* method must return false.

The *oscpu* attribute's getter must return either the empty string or a string representing the platform on which the browser is executing, e.g. "Windows NT 10.0; Win64; x64", "Linux x86\_64".

(This

is a

tracking

[vector.](#)) Any information in this API that varies from user to user can be used to profile the user. In fact, if enough such information is available, a user can actually be uniquely identified. For this reason, user agent implementers are strongly urged to include as little information in this API as possible.

### 8.9.1.2 Language preferences

```
interface mixin NavigatorLanguage {
 readonly attribute DOMString language;
 readonly attribute FrozenArray<DOMString> languages;
};
```

**[self.navigator.language](#)**



[Navigator/language](#)

Support in all current engines.

Firefox1+Safari1+Chrome1+

---

Opera4+Edge79+

---

Edge (Legacy)12+Internet Explorer11

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

## [WorkerNavigator/language](#)

Support in all current engines.

Firefox3.5+Safari10+Chrome4+

---

Opera4+Edge79+

---

Edge (Legacy)12+Internet Explorer11

---

Firefox Android4+Safari iOS10+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android10.1+

Returns a language tag representing the user's preferred language.

## [self.navigator.languages](#)

✓MDN

## [Navigator/languages](#)

Support in all current engines.

Firefox32+Safari10.1+Chrome37+

---

Opera24+Edge79+

---

Edge (Legacy)16+Internet ExplorerNo

---

Firefox Android32+Safari iOS10.3+Chrome Android37+WebView Android37+Samsung Internet3.0+Opera Android24+

## [WorkerNavigator/languages](#)

Support in all current engines.

Firefox32+Safari10.1+Chrome37+

---

Opera24+Edge79+

---

Edge (Legacy)16+Internet ExplorerNo

---

Firefox Android32+Safari iOS10.3+Chrome Android37+WebView Android37+Samsung Internet3.0+Opera Android24+

Returns an array of language tags representing the user's preferred languages, with the most preferred language first.

The most preferred language is the one returned by [navigator.language](#).

A [languagechange](#) event is fired at the [Window](#) or [WorkerGlobalScope](#) object when the user agent's understanding of what the user's preferred languages are changes.

## **Language**

Must return a valid BCP 47 language tag representing either [a plausible language](#) or the user's most preferred language. [\[BCP47\]](#)

## **Languages**

Must return a [frozen array](#) of valid BCP 47 language tags representing either one or more [plausible languages](#), or the user's preferred languages, ordered by preference with the most preferred language first. The same object must be returned until the user agent needs to return different values, or values in a different order. [\[BCP47\]](#)

Whenever the user agent needs to make the [navigator.languages](#) attribute of a [Window](#) or [WorkerGlobalScope](#) object *global* return a new set of language tags, the user agent must [queue a global task](#) on the [DOM manipulation task source](#) given *global* to [fire an event](#) named [languagechange](#) at *global*, and wait until that task begins to be executed before actually returning a new value.

To determine a *plausible language*, the user agent should bear in mind the following:

(This  
is a  
tracking

- [Any information in this API that varies from user to user can be used to profile or identify the user.](#)
- If the user is not using a service that obfuscates the user's point of origin (e.g. the Tor anonymity network), then the value that is least likely to distinguish the user from other users with similar origins (e.g. from the same IP address block) is the language used by the majority of such users. [\[TOR\]](#)
- If the user is using an anonymizing service, then the value "en-US" is suggested; if all users of the service use that same value, that reduces the possibility of distinguishing the users from each other.

(This  
is a  
tracking  
vector.)

To avoid introducing any more fingerprinting vectors, user agents should use the same list for the APIs defined in this function as for the HTTP '[Accept-Language](#)' header.

### 8.9.1.3 Browser state

```
interface mixin NavigatorOnLine {
 readonly attribute boolean onLine;
};
```

## [`self.navigator.onLine`](#)

✓MDN

### [Navigator/onLine](#)

Support in all current engines.

Firefox 1.5+ Safari 4+ Chrome 1+

Opera 3+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 4+

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 10.1+

### [WorkerNavigator/onLine](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

Returns false if the user agent is definitely offline (disconnected from the network). Returns true if the user agent might be online.

The events [online](#) and [offline](#) are fired when the value of this attribute changes.

The `onLine` attribute must return false if the user agent will not contact the network when the user follows links or when a script requests a remote page (or knows that such an attempt would fail), and must return true otherwise.

When the value that would be returned by the [navigator.onLine](#) attribute of a [Window](#) or [WorkerGlobalScope](#) global changes from true to false, the user agent must [queue a global task](#) on the [networking task source](#) given `global` to [fire an event](#) named [offline](#) at `global`.

On the other hand, when the value that would be returned by the [navigator.onLine](#) attribute of a [Window](#) or [WorkerGlobalScope](#) global changes from false to true, the user agent must [queue a global task](#) on the [networking task source](#) given `global` to [fire an event](#) named [online](#) at the [Window](#) or [WorkerGlobalScope](#) object.

This attribute is inherently unreliable. A computer can be connected to a network without having Internet access.

In this example, an indicator is updated as the browser goes online and offline.

```

<!DOCTYPE HTML>
<html lang="en">
<head>
 <title>Online status</title>
 <script>
 function updateIndicator() {
 document.getElementById('indicator').textContent = navigator.onLine ? 'online' : 'offline';
 }
 </script>
</head>
<body onload="updateIndicator()" ononline="updateIndicator()" onoffline="updateIndicator()">
 <p>The network is: (state unknown)
</body>
</html>

```

8.9.1.4 Custom scheme handlers: the [registerProtocolHandler\(\)](#) method

MDN

[Navigator/registerProtocolHandler](#)

Firefox 3+ Safari No Chrome 13+

---

Opera 11.6+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android No Safari iOS No Chrome Android No WebView Android No Samsung Internet No Opera Android No

```

interface mixin NavigatorContentUtils {
 [SecureContext] undefined registerProtocolHandler(DOMString scheme, USVString url);
 [SecureContext] undefined unregisterProtocolHandler(DOMString scheme, USVString url);
};

```

**window.navigator.registerProtocolHandler(scheme, url)**

Registers a handler for *scheme* at *url*. For example, an online telephone messaging service could register itself as a handler of the [sms:](#) scheme, so that if the user clicks on such a link, they are given the opportunity to use that web site. [\[SMS\]](#)

The string "%s" in *url* is used as a placeholder for where to put the URL of the content to be handled.

Throws a ["SecurityError" DOMException](#) if the user agent blocks the registration (this might happen if trying to register as a handler for "http", for instance).

Throws a ["SyntaxError" DOMException](#) if the "%s" string is missing in *url*.

## `window.navigator.unregisterProtocolHandler(scheme, url)`

Unregisters the handler given by the arguments.

Throws a "[SecurityError](#)" [DOMException](#) if the user agent blocks the deregistration (this might happen if with invalid schemes, for instance).

Throws a "[SyntaxError](#)" [DOMException](#) if the "%s" string is missing in `url`.

The `registerProtocolHandler(scheme, url)` method steps are:

1. Let (`normalizedScheme`, `normalizedURLString`) be the result of running [normalize protocol handler parameters](#) with `scheme`, `url`, and `this`'s [relevant settings object](#).
2. [In parallel](#): register a protocol handler for `normalizedScheme` and `normalizedURLString`. User agents may, within the constraints described, do whatever they like. A user agent could, for instance, prompt the user and offer the user the opportunity to add the site to a shortlist of handlers, or make the handlers their default, or cancel the request. User agents could also silently collect the information, providing it only when relevant to the user.

User agents should keep track of which sites have registered handlers (even if the user has declined such registrations) so that the user is not repeatedly prompted with the same request.

When the user agent uses `this` handler for a [URL](#) `inputURL`:

1. Assert: `inputURL`'s [scheme](#) is `normalizedScheme`.
2. Let `inputURLString` be the [serialization](#) of `inputURL`.
3. Let `encodedURL` be the result of running [UTF-8 percent-encode](#) on `inputURLString` using the [component percent-encode set](#).
4. Let `handlerURLString` be `normalizedURLString`.
5. Replace the first instance of "%s" in `handlerURLString` with `encodedURL`.
6. Let `resultURL` be the result of [parsing](#) `handlerURLString`.
7. [Navigate](#) an appropriate [browsing context](#) to `resultURL`.

If the user had visited a site at `https://example.com/` that made the following call:

```
navigator.registerProtocolHandler('web+soup', 'soup?url=%s')
```

...and then, much later, while visiting `https://www.example.net/`, clicked on a link such as:

```
Download our Chicken Kiwi soup!
```

...then the UA might navigate to the following URL:

<https://example.com/soup?url=web+soup:chicken-kiwi>

This site could then do whatever it is that it does with soup (synthesize it and ship it to the user, or whatever).

This does not define when the handler is used. To some extent, the [processing model for navigating across documents](#) defines some cases where it is relevant, but in general user agents may use this information wherever they would otherwise consider handing schemes to native plugins or helper applications.

The `unregisterProtocolHandler(scheme, url)` method steps are:

1. Let `(normalizedScheme, normalizedURLString)` be the result of running [normalize protocol handler parameters](#) with `scheme`, `url`, and `this`'s [relevant settings object](#).
  2. [In parallel](#): unregister the handler described by `normalizedScheme` and `normalizedURLString`.
- 

To [normalize protocol handler parameters](#), given a string `scheme`, a string `url`, and an [environment settings object](#) `environment`, run these steps:

1. Set `scheme` to `scheme`, [converted to ASCII lowercase](#).
2. If `scheme` is neither a [safelisted scheme](#) nor a string starting with "web+" followed by one or more [ASCII lower alphas](#), then throw a ["SecurityError" DOMException](#).

This means that including a colon in `scheme` (as in "mailto:") will throw.

The following schemes are the [safelisted schemes](#):

- bitcoin
- geo
- im
- irc
- ircs
- magnet
- mailto
- matrix
- mms
- news
- nntp
- openpgp4fpr

- `sip`
- `sms`
- `smsto`
- `ssh`
- `tel`
- `urn`
- `webcal`
- `wtai`
- `xmpp`

This list can be changed. If there are schemes that ought to be added, please send feedback.

3. If *url* does not contain "%s", then throw a "[SyntaxError](#)" [DOMException](#).
4. [Parse](#) *url* relative to *environment*.
5. If that fails, then throw a "[SyntaxError](#)" [DOMException](#).

This is forcibly the case if the %s placeholder is in the host or port of the URL.

6. If the [resulting URL record](#)'s [scheme](#) is not an [HTTP\(S\) scheme](#) or the [resulting URL record](#)'s [origin](#) is not [same origin](#) with *environment*'s [origin](#), then throw a "[SecurityError](#)" [DOMException](#).
7. Assert: the result of [Is url potentially trustworthy?](#) given the [resulting URL record](#) is "Potentially Trustworthy".

Because [normalize protocol handler parameters](#) is run within a [secure context](#), this is implied by the [same origin](#) condition.

8. Return (*scheme*, [resulting URL string](#)).

The [resulting URL string](#) will by definition not be a [valid URL string](#) as it includes the string "%s" which is not a valid component in a URL.

#### 8.9.1.4.1 Security and privacy

Custom scheme handlers can introduce a number of concerns, in particular privacy concerns.

**Hijacking all web usage.** User agents should not allow schemes that are key to its normal operation, such as an [HTTP\(S\) scheme](#), to be rerouted through third-party sites. This would allow a user's activities to be trivially tracked, and would allow user information, even in secure connections, to be collected.

**Hijacking defaults.** User agents are strongly urged to not automatically change any defaults, as this could lead the user to send data to remote hosts that the user is not expecting. New

handlers registering themselves should never automatically cause those sites to be used.

**Registration spamming.** User agents should consider the possibility that a site will attempt to register a large number of handlers, possibly from multiple domains (e.g., by redirecting through a series of pages each on a different domain, and each registering a handler for **web+spam**: — analogous practices abusing other web browser features have been used by pornography web sites for many years). User agents should gracefully handle such hostile attempts, protecting the user.

**Hostile handler metadata.** User agents should protect against typical attacks against strings embedded in their interface, for example ensuring that markup or escape characters in such strings are not executed, that null bytes are properly handled, that over-long strings do not cause crashes or buffer overruns, and so forth.

**Leaking private data.** Web page authors may reference a custom scheme handler using URL data considered private. They might do so with the expectation that the user's choice of handler points to a page inside the organization, ensuring that sensitive data will not be exposed to third parties. However, a user may have registered a handler pointing to an external site, resulting in a data leak to that third party. Implementers might wish to consider allowing administrators to disable custom handlers on certain subdomains, content types, or schemes.

**Leaking credentials.** User agents must never send username or password information in the URLs that are escaped and included sent to the handler sites. User agents may even avoid attempting to pass to web-based handlers the URLs of resources that are known to require authentication to access, as such sites would be unable to access the resources in question without prompting the user for credentials themselves (a practice that would require the user to know whether to trust the third-party handler, a decision many users are unable to make or even understand).

**Interface interference.** User agents should be prepared to handle intentionally long arguments to the methods. For example, if the user interface exposed consists of an "accept" button and a "deny" button, with the "accept" binding containing the name of the handler, it's important that a long name not cause the "deny" button to be pushed off the screen.

#### 8.9.1.5 Cookies

```
interface mixin NavigatorCookies {
 readonly attribute boolean cookieEnabled;
};
```

[window.navigator.cookieEnabled](#)



[Navigator/cookieEnabled](#)

Support in all current engines.

---

Firefox1+Safari1+Chrome1+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer4+

---

Firefox Android4+Safari iOS1+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12.1+

Returns false if setting a cookie will be ignored, and true otherwise.

The *cookieEnabled* attribute must return true if the user agent attempts to handle cookies according to *HTTP State Management Mechanism*, and false if it ignores cookie change requests. [\[COOKIES\]](#)

#### 8.9.1.6 PDF viewing support

##### **window.navigator.pdfViewerEnabled**

Returns true if the user agent supports inline viewing of PDF files when [navigating](#) to them, or false otherwise. In the latter case, PDF files will be handled by [external software](#).

```
interface mixin NavigatorPlugins {
 [SameObject] readonly attribute PluginArray plugins;
 [SameObject] readonly attribute MimeTypeArray mimeTypes;
 boolean javaEnabled();
 readonly attribute boolean pdfViewerEnabled;
};
```

```
[Exposed=Window,
 LegacyUnenumerableNamedProperties]
interface PluginArray {
 undefined refresh();
 readonly attribute unsigned long length;
 getter Plugin? item(unsigned long index);
 getter Plugin? namedItem(DOMString name);
};
```

```
[Exposed=Window,
 LegacyUnenumerableNamedProperties]
interface MimeTypeArray {
 readonly attribute unsigned long length;
 getter MimeType? item(unsigned long index);
 getter MimeType? namedItem(DOMString name);
};
```

```
[Exposed=Window,
 LegacyUnenumerableNamedProperties]
interface Plugin {
 readonly attribute DOMString name;
```

```
readonly attribute DOMString description;
readonly attribute DOMString filename;
readonly attribute unsigned long length;
getter MimeType? item(unsigned long index);
getter MimeType? namedItem(DOMString name);
};
```

```
[Exposed=Window]
interface MimeType {
 readonly attribute DOMString type;
 readonly attribute DOMString description;
 readonly attribute DOMString suffixes;
 readonly attribute Plugin enabledPlugin;
};
```

Although these days detecting PDF viewer support can be done via [navigator.pdfViewerEnabled](#), for historical reasons, there are a number of complex and intertwined interfaces that provide the same capability, which legacy code relies on. This section specifies both the simple modern variant and the complicated historical one.

Each user agent has a *PDF viewer supported* boolean, whose value is [implementation-defined](#) (and might vary according to user preferences).

This value also impacts the [navigation](#) processing model.

---

Each [Window](#) object has a *PDF viewer plugin objects* list. If the user agent's [PDF viewer supported](#) is false, then it is the empty list. Otherwise, it is a list containing five [Plugin](#) objects, whose [names](#) are, respectively:

0. "PDF Viewer"
1. "Chrome PDF Viewer"
2. "Chromium PDF Viewer"
3. "Microsoft Edge PDF Viewer"
4. "WebKit built-in PDF"

The values of the above list form the *PDF viewer plugin names* list.

These names were chosen based on evidence of what websites historically search for, and thus what is necessary for user agents to expose in order to maintain compatibility with existing content. They are ordered alphabetically. The "PDF Viewer" name was then inserted in the 0th position so that the [enabledPlugin](#) getter could point to a generic plugin name.

Each [Window](#) object has a *PDF viewer mime type objects* list. If the user agent's [PDF viewer supported](#) is false, then it is the empty list. Otherwise, it is a list containing two [MimeType](#) objects, whose [types](#) are, respectively:

0. "application/pdf"
1. "text/pdf"

The values of the above list form the *PDF viewer mime types* list.

---

Each [NavigatorPlugins](#) object has a *plugins array*, which is a new [PluginArray](#), and a *mime types array*, which is a new [MimeTypeArray](#).

The [NavigatorPlugins](#) mixin's *plugins* getter steps are to return [this](#)'s [plugins array](#).

The [NavigatorPlugins](#) mixin's *mimeTypes* getter steps are to return [this](#)'s [mime types array](#).

The [NavigatorPlugins](#) mixin's *javaEnabled()* method steps are to return false.

The [NavigatorPlugins](#) mixin's *pdfViewerEnabled* getter steps are to return the user agent's [PDF viewer supported](#).

---

The [PluginArray](#) interface [supports named properties](#). If the user agent's [PDF viewer supported](#) is true, then they are the [PDF viewer plugin names](#). Otherwise, they are the empty list.

The [PluginArray](#) interface's *namedItem(name)* method steps are:

1. [For each Plugin plugin of this's relevant global object's PDF viewer plugin objects](#): if *plugin*'s [name](#) is *name*, then return *plugin*.
2. Return null.

The [PluginArray](#) interface [supports indexed properties](#). The [supported property indices](#) are the [indices of this's relevant global object's PDF viewer plugin objects](#).

The [PluginArray](#) interface's *item(index)* method steps are:

1. Let *plugins* be [this](#)'s [relevant global object](#)'s [PDF viewer plugin objects](#).
2. If *index* < *plugins*'s [size](#), then return *plugins*[*index*].
3. Return null.

The [PluginArray](#) interface's *length* getter steps are to return [this](#)'s [relevant global object](#)'s [PDF viewer plugin objects](#)'s [size](#).

The [PluginArray](#) interface's *refresh()* method steps are to do nothing.

---

The [MimeTypeArray](#) interface [supports named properties](#). If the user agent's [PDF viewer supported](#) is true, then they are the [PDF viewer mime types](#). Otherwise, they are the empty list.

The [MimeTypeArray](#) interface's *namedItem(name)* method steps are:

1. [For each MimeType mimeType of this's relevant global object's PDF viewer mime type objects](#): if mimeType's [type](#) is *name*, then return *mimeType*.
2. Return null.

The [MimeTypeArray](#) interface [supports indexed properties](#). The [supported property indices](#) are the [indices of this's relevant global object's PDF viewer mime type objects](#).

The [MimeTypeArray](#) interface's *item(index)* method steps are:

1. Let *mimeTypes* be [this's relevant global object's PDF viewer mime type objects](#).
2. If *index* < *mimeTypes*'s [size](#), then return *mimeTypes[index]*.
3. Return null.

The [MimeTypeArray](#) interface's *length* getter steps are to return [this's relevant global object's PDF viewer mime type objects's size](#).

---

Each [Plugin](#) object has a *name*, which is set when the object is created.

The [Plugin](#) interface's *name* getter steps are to return [this's name](#).

The [Plugin](#) interface's *description* getter steps are to return "Portable Document Format".

The [Plugin](#) interface's *filename* getter steps are to return "internal-pdf-viewer".

The [Plugin](#) interface [supports named properties](#). If the user agent's [PDF viewer supported](#) is true, then they are the [PDF viewer mime types](#). Otherwise, they are the empty list.

The [Plugin](#) interface's *namedItem(name)* method steps are:

1. [For each MimeType mimeType of this's relevant global object's PDF viewer mime type objects](#): if mimeType's [type](#) is *name*, then return *mimeType*.
2. Return null.

The [Plugin](#) interface [supports indexed properties](#). The [supported property indices](#) are the [indices of this's relevant global object's PDF viewer mime type objects](#).

The [Plugin](#) interface's *item(index)* method steps are:

1. Let *mimeTypes* be [\*this\*'s relevant global object's PDF viewer mime type objects](#).
2. If *index* < *mimeType*'s [\*size\*](#), then return *mimeTypes*[*index*].
3. Return null.

The [Plugin](#) interface's *length* getter steps are to return [\*this\*'s relevant global object's PDF viewer mime type objects's size](#).

---

Each [MimeType](#) object has a *type*, which is set when the object is created.

The [MimeType](#) interface's *type* getter steps are to return [\*this\*'s type](#).

The [MimeType](#) interface's *description* getter steps are to return "Portable Document Format".

The [MimeType](#) interface's *suffixes* getter steps are to return "pdf".

The [MimeType](#) interface's *enabledPlugin* getter steps are to return [\*this\*'s relevant global object's PDF viewer plugin objects\[0\]](#) (i.e., the generic "PDF Viewer" one).

## 8.10 Images

MDN

### [ImageBitmap](#)

Firefox 42+ Safari No Chrome 50+

Opera 37+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 42+ Safari iOS No Chrome Android 50+ WebView Android 50+ Samsung Internet 5.0+ Opera Android 37+

```
[Exposed=(Window,Worker), Serializable, Transferable]
interface ImageBitmap {
 readonly attribute unsigned long width;
 readonly attribute unsigned long height;
 undefined close\(\);
};

typedef (CanvasImageSource or
 Blob or
 ImageData) ImageBitmapSource;
```

```

enum ImageOrientation { "none", "flipY" };
enum PremultiplyAlpha { "none", "premultiply", "default" };
enum ColorSpaceConversion { "none", "default" };
enum ResizeQuality { "pixelated", "low", "medium", "high" };

dictionary ImageBitmapOptions {
 ImageOrientation imageOrientation = "none";
 PremultiplyAlpha premultiplyAlpha = "default";
 ColorSpaceConversion colorSpaceConversion = "default";
 [EnforceRange] unsigned long resizeWidth;
 [EnforceRange] unsigned long resizeHeight;
 ResizeQuality resizeQuality = "low";
};

}

```

An [ImageBitmap](#) object represents a bitmap image that can be painted to a canvas without undue latency.

The exact judgement of what is undue latency of this is left up to the implementer, but in general if making use of the bitmap requires network I/O, or even local disk I/O, then the latency is probably undue; whereas if it only requires a blocking read from a GPU or system RAM, the latency is probably acceptable.

**`promise = self.createImageBitmap(image [, options ])`**

✓MDN

[createImageBitmap](#)

Support in all current engines.

Firefox 42+ Safari 15+ Chrome 50+

---

Opera Yes Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android Yes Safari iOS 15+ Chrome Android 50+ WebView Android 50+ Samsung Internet 5.0+ Opera Android Yes

**`promise = self.createImageBitmap(image, sx, sy, sw, sh [, options ])`**

Takes *image*, which can be an [img](#) element, an [SVG image](#) element, a [video](#) element, a [canvas](#) element, a [Blob](#) object, an [ImageData](#) object, or another [ImageBitmap](#) object, and returns a promise that is resolved when a new [ImageBitmap](#) is created.

If no [ImageBitmap](#) object can be constructed, for example because the provided *image* data is not actually an image, then the promise is rejected instead.

If *sx*, *sy*, *sw*, and *sh* arguments are provided, the source image is cropped to the given pixels, with any pixels missing in the original replaced by [transparent black](#). These

coordinates are in the source image's pixel coordinate space, *not* in [CSS pixels](#).

If *options* is provided, the [\*\*ImageBitmap\*\*](#) object's bitmap data is modified according to *options*. For example, if the [\*\*premultiplyAlpha\*\*](#) option is set to "[\*\*premultiply\*\*](#)", the [\*\*bitmap data\*\*](#)'s color channels are [\*\*premultiplied by its alpha channel\*\*](#).

Rejects the promise with an "[\*\*InvalidStateError\*\*](#)" [\*\*DOMException\*\*](#) if the source image is not in a valid state (e.g., an [\*\*img\*\*](#) element that hasn't loaded successfully, an [\*\*ImageBitmap\*\*](#) object whose [\*\*\[\[Detached\]\]\*\*](#) internal slot value is true, an [\*\*ImageData\*\*](#) object whose [\*\*data\*\*](#) attribute value's [\*\*\[\[ViewedArrayBuffer\]\]\*\*](#) internal slot is detached, or a [\*\*Blob\*\*](#) whose data cannot be interpreted as a bitmap image).

Rejects the promise with a "[\*\*SecurityError\*\*](#)" [\*\*DOMException\*\*](#) if the script is not allowed to access the image data of the source image (e.g. a [\*\*video\*\*](#) that is [\*\*CORS-cross-origin\*\*](#), or a [\*\*canvas\*\*](#) being drawn on by a script in a worker from another [\*\*origin\*\*](#)).

### ***imageBitmap.close()***

MDN

#### [ImageBitmap/close](#)

---

Firefox 46+ Safari No Chrome 52+

---

Opera 37+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 46+ Safari iOS No Chrome Android 52+ WebView Android 52+ Samsung Internet 6.0+ Opera Android 37+

Releases *imageBitmap*'s underlying [\*\*bitmap data\*\*](#).

### ***imageBitmap.width***

MDN

#### [ImageBitmap/width](#)

---

Firefox 42+ Safari No Chrome 50+

---

Opera 37+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 42+ Safari iOS No Chrome Android 50+ WebView Android 50+ Samsung Internet 5.0+ Opera Android 37+

Returns the [\*\*intrinsic width\*\*](#) of the image, in [CSS pixels](#).

### ***imageBitmap.height***

MDN

## [ImageBitmap/height](#)

Firefox 42+ Safari No Chrome 50+

Opera 37+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 42+ Safari iOS No Chrome Android 50+ WebView Android 50+ Samsung

Internet 5.0+ Opera Android 37+

Returns the [intrinsic height](#) of the image, in [CSS pixels](#).

An [ImageBitmap](#) object whose [\[\[Detached\]\]](#) internal slot value is false always has associated *bitmap data*, with a width and a height. However, it is possible for this data to be corrupted. If an [ImageBitmap](#) object's media data can be decoded without errors, it is said to be *fully decodable*.

An [ImageBitmap](#) object's bitmap has an [origin-clean](#) flag, which indicates whether the bitmap is tainted by content from a different [origin](#). The flag is initially set to true and may be changed to false by the steps of [createImageBitmap\(\)](#).

---

[ImageBitmap](#) objects are [serializable objects](#) and [transferable objects](#).

Their [serialization steps](#), given *value* and *serialized*, are:

1. If *value*'s [origin-clean](#) flag is not set, then throw a ["DataCloneError"](#) [DOMException](#).
2. Set *serialized*.[\[\[BitmapData\]\]](#) to a copy of *value*'s [bitmap data](#).

Their [deserialization steps](#), given *serialized* and *value*, are:

1. Set *value*'s [bitmap data](#) to *serialized*.[\[\[BitmapData\]\]](#).

Their [transfer steps](#), given *value* and *dataHolder*, are:

1. If *value*'s [origin-clean](#) flag is not set, then throw a ["DataCloneError"](#) [DOMException](#).
2. Set *dataHolder*.[\[\[BitmapData\]\]](#) to *value*'s [bitmap data](#).
3. Unset *value*'s [bitmap data](#).

Their [transfer-receiving steps](#), given *dataHolder* and *value*, are:

1. Set *value*'s [bitmap data](#) to *dataHolder*.[\[\[BitmapData\]\]](#).

The `createImageBitmap(image, options)` and `createImageBitmap(image sx, sy, sw, sh, options)` methods, when invoked, must run these steps:

1. Let  $p$  be a new promise.
2. If either  $sw$  or  $sh$  is given and is 0, then return  $p$  rejected with a [RangeError](#).
3. If either  $options$ 's `resizeWidth` or  $options$ 's `resizeHeight` is present and is 0, then return  $p$  rejected with an "[InvalidStateError](#)" [DOMException](#).
4. [Check the usability of the `image` argument](#). If this throws an exception or returns `bad`, then return  $p$  rejected with an "[InvalidStateError](#)" [DOMException](#).
5. Let  $imageBitmap$  be a new [ImageBitmap](#) object.
6. Switch on  $image$ :

### [img](#) [SVG image](#)

1. If  $image$ 's media data has no [intrinsic dimensions](#) (e.g., it's a vector graphic with no specified content size) and either  $options$ 's `resizeWidth` or  $options$ 's `resizeHeight` is not present, then return  $p$  rejected with an "[InvalidStateError](#)" [DOMException](#).
2. If  $image$ 's media data has no [intrinsic dimensions](#) (e.g., it's a vector graphics with no specified content size), it should be rendered to a bitmap of the size specified by the `resizeWidth` and the `resizeHeight` options.
3. Set  $imageBitmap$ 's [bitmap data](#) to a copy of  $image$ 's media data, [cropped to the source rectangle with formatting](#). If this is an animated image,  $imageBitmap$ 's [bitmap data](#) must only be taken from the default image of the animation (the one that the format defines is to be used when animation is not supported or is disabled), or, if there is no such image, the first frame of the animation.
4. If  $image$  [is not origin-clean](#), then set the [origin-clean](#) flag of  $imageBitmap$ 's bitmap to false.
5. Run this step [in parallel](#):
  1. Resolve  $p$  with  $imageBitmap$ .

### [video](#)

1. If  $image$ 's [networkState](#) attribute is [NETWORK\\_EMPTY](#), then return  $p$  rejected with an "[InvalidStateError](#)" [DOMException](#).

2. Set *imageBitmap*'s [bitmap data](#) to a copy of the frame at the [current playback position](#), at the [media resource](#)'s [intrinsic width](#) and [intrinsic height](#) (i.e., after any aspect-ratio correction has been applied), [cropped to the source rectangle with formatting](#).
3. If *image* [is not origin-clean](#), then set the [origin-clean](#) flag of *imageBitmap*'s bitmap to false.
4. Run this step [in parallel](#):
  1. Resolve *p* with *imageBitmap*.

## [canvas](#)

1. Set *imageBitmap*'s [bitmap data](#) to a copy of *image*'s [bitmap data](#), [cropped to the source rectangle with formatting](#).
2. Set the [origin-clean](#) flag of the *imageBitmap*'s bitmap to the same value as the [origin-clean](#) flag of *image*'s bitmap.
3. Run this step [in parallel](#):
  1. Resolve *p* with *imageBitmap*.

## [Blob](#)

Run these step [in parallel](#):

1. Let *imageData* be the result of reading *image*'s data. If an [error occurs during reading of the object](#), then reject *p* with an ["InvalidStateError" DOMException](#) and abort these steps.
2. Apply the [image sniffing rules](#) to determine the file format of *imageData*, with MIME type of *image* (as given by *image*'s [type](#) attribute) giving the official type.
3. If *imageData* is not in a supported image file format (e.g., it's not an image at all), or if *imageData* is corrupted in some fatal way such that the image dimensions cannot be obtained (e.g., a vector graphic with no intrinsic size), then reject *p* with an ["InvalidStateError" DOMException](#) and abort these steps.
4. Set *imageBitmap*'s [bitmap data](#) to *imageData*, [cropped to the source rectangle with formatting](#). If this is an animated image, *imageBitmap*'s [bitmap data](#) must only be taken from the default image of the animation (the one that the format defines is to be used when animation is not supported or is disabled), or, if there is no such image, the first frame of the animation.

5. Resolve  $p$  with  $imageBitmap$ .

### ImageData

1. Let  $buffer$  be  $image$ 's data attribute value's [[ViewedArrayBuffer]] internal slot.
2. If IsDetachedBuffer( $buffer$ ) is true, then return  $p$  rejected with an "InvalidStateError" DOMException.
3. Set  $imageBitmap$ 's bitmap data to  $image$ 's image data, cropped to the source rectangle with formatting.
4. Run this step in parallel:
  1. Resolve  $p$  with  $imageBitmap$ .

### ImageBitmap

1. Set  $imageBitmap$ 's bitmap data to a copy of  $image$ 's bitmap data, cropped to the source rectangle with formatting.
2. Set the origin-clean flag of  $imageBitmap$ 's bitmap to the same value as the origin-clean flag of  $image$ 's bitmap.
3. Run this step in parallel:
  1. Resolve  $p$  with  $imageBitmap$ .

### VideoFrame

1. Set  $imageBitmap$ 's bitmap data to a copy of  $image$ 's visible pixel data, cropped to the source rectangle with formatting.
2. Run this step in parallel:
  1. Resolve  $p$  with  $imageBitmap$ .
7. Return  $p$ .

When the steps above require that the user agent *crop bitmap data to the source rectangle with formatting*, the user agent must run the following steps:

1. Let  $input$  be the bitmap data being transformed.
2. If  $sx$ ,  $sy$ ,  $sw$  and  $sh$  are specified, let  $sourceRectangle$  be a rectangle whose corners are the four points  $(sx, sy)$ ,  $(sx+sw, sy)$ ,  $(sx+sw, sy+sh)$ ,  $(sx, sy+sh)$ . Otherwise let  $sourceRectangle$  be a rectangle whose corners are the four points  $(0,0)$ ,  $(\text{width of } input, \text{height of } input)$ .

$(0, (\text{width of } \textit{input}, \text{height of } \textit{input}), (0, \text{height of } \textit{input}))$ .

If either  $\text{sw}$  or  $\text{sh}$  are negative, then the top-left corner of this rectangle will be to the left or above the  $(\text{sx}, \text{sy})$  point.

3. Let  $\text{outputWidth}$  be determined as follows:

If the **`resizeWidth`** member of *options* is specified  
the value of the **`resizeWidth`** member of *options*

If the **`resizeWidth`** member of *options* is not specified, but the **`resizeHeight`** member is specified

the width of *sourceRectangle*, times the value of the **`resizeHeight`** member of *options*, divided by the height of *sourceRectangle*, rounded up to the nearest integer

If neither **`resizeWidth`** nor **`resizeHeight`** are specified  
the width of *sourceRectangle*

4. Let  $\text{outputHeight}$  be determined as follows:

If the **`resizeHeight`** member of *options* is specified  
the value of the **`resizeHeight`** member of *options*

If the **`resizeHeight`** member of *options* is not specified, but the **`resizeWidth`** member is specified

the height of *sourceRectangle*, times the value of the **`resizeWidth`** member of *options*, divided by the width of *sourceRectangle*, rounded up to the nearest integer

If neither **`resizeWidth`** nor **`resizeHeight`** are specified  
the height of *sourceRectangle*

5. Place *input* on an infinite **`transparent black`** grid plane, positioned so that its top left corner is at the origin of the plane, with the  $x$ -coordinate increasing to the right, and the  $y$ -coordinate increasing down, and with each pixel in the *input* image data occupying a cell on the plane's grid.

6. Let *output* be the rectangle on the plane denoted by *sourceRectangle*.

7. Scale *output* to the size specified by  $\text{outputWidth}$  and  $\text{outputHeight}$ . The user agent should use the value of the **`resizeQuality`** option to guide the choice of scaling algorithm.

8. If the value of the **`imageOrientation`** member of *options* is "*flipY*", *output* must be flipped vertically, disregarding any image orientation metadata of the source (such as EXIF metadata), if any. [\[EXIF\]](#)

If the value is "*none*", no extra step is required.

9. If *image* is an [img](#) element or a [Blob](#) object, let *val* be the value of the *colorSpaceConversion* member of *options*, and then run these substeps:
  1. If *val* is "**default**", the color space conversion behavior is implementation-specific, and should be chosen according to the default color space that the implementation uses for drawing images onto the canvas.
  2. If *val* is "**none**", *output* must be decoded without performing any color space conversions. This means that the image decoding algorithm must ignore color profile metadata embedded in the source data as well as the display device color profile.
10. Let *val* be the value of *premultiplyAlpha* member of *options*, and then run these substeps:
  1. If *val* is "**default**", the alpha premultiplication behavior is implementation-specific, and should be chosen according to implementation deems optimal for drawing images onto the canvas.
  2. If *val* is "**premultiply**", the *output* that is not premultiplied by alpha must have its color components [multiplied by alpha](#) and that is premultiplied by alpha must be left untouched.
  3. If *val* is "**none**", the *output* that is not premultiplied by alpha must be left untouched and that is premultiplied by alpha must have its color components [divided by alpha](#).
11. Return *output*.

The *close()* method steps are:

1. Set [\*this\*'s \[\[Detached\]\]](#) internal slot value to true.
2. Unset [\*this\*'s bitmap data](#).

The *width* getter steps are:

1. If [\*this\*'s \[\[Detached\]\]](#) internal slot's value is true, then return 0.
2. Return [\*this\*'s width, in CSS pixels](#).

The *height* getter steps are:

1. If [\*this\*'s \[\[Detached\]\]](#) internal slot's value is true, then return 0.
2. Return [\*this\*'s height, in CSS pixels](#).

The [ResizeQuality](#) enumeration is used to express a preference for the interpolation quality

to use when scaling images.

The "*pixelated*" value indicates a preference to scale the image that maximizes the appearance. Scaling algorithms that "smooth" colors are acceptable, such as bilinear interpolation.

The "*low*" value indicates a preference for a low level of image interpolation quality. Low-quality image interpolation may be more computationally efficient than higher settings.

The "*medium*" value indicates a preference for a medium level of image interpolation quality.

The "*high*" value indicates a preference for a high level of image interpolation quality. High-quality image interpolation may be more computationally expensive than lower settings.

Bilinear scaling is an example of a relatively fast, lower-quality image-smoothing algorithm. Bicubic or Lanczos scaling are examples of image-scaling algorithms that produce higher-quality output. This specification does not mandate that specific interpolation algorithms be used unless the value is "[pixelated](#)".

Using this API, a sprite sheet can be precut and prepared:

```
var sprites = {};
function loadMySprites() {
 var image = new Image();
 image.src = 'mysprites.png';
 var resolver;
 var promise = new Promise(function (arg) { resolver = arg });
 image.onload = function () {
 resolver(Promise.all([
 createImageBitmap(image, 0, 0, 40, 40).then(function (image) { sprites.tree = image }),
 createImageBitmap(image, 40, 0, 40, 40).then(function (image) { sprites.snake = image }),
 createImageBitmap(image, 80, 0, 40, 40).then(function (image) { sprites.bird = image }),
 createImageBitmap(image, 0, 40, 40, 40).then(function (image) { sprites.bird = image }),
 createImageBitmap(image, 40, 40, 40, 40).then(function (image) { sprites.bird = image }),
 createImageBitmap(image, 80, 40, 40, 40).then(function (image) { sprites.bird = image })
]));
 };
 return promise;
}

function runDemo() {
 var canvas = document.querySelector('canvas#demo');
 var context = canvas.getContext('2d');
 context.drawImage(sprites.tree, 30, 10);
 context.drawImage(sprites.snake, 70, 10);
}
```

```
loadMySprites().then(runDemo);
```

## 8.11 Animation frames

Some objects include the [AnimationFrameProvider](#) interface mixin.

```
callback FrameRequestCallback = undefined (DOMHighResTimeStamp time);

interface mixin AnimationFrameProvider {
 unsigned long requestAnimationFrame(FrameRequestCallback callback);
 undefined cancelAnimationFrame(unsigned long handle);
};

Window includes AnimationFrameProvider;
DedicatedWorkerGlobalScope includes AnimationFrameProvider;
```

Each [AnimationFrameProvider](#) object also has a *target object* that stores the provider's internal state. It is defined as follows:

If the [AnimationFrameProvider](#) is a [Window](#)

The [Window](#)'s associated [Document](#)

If the [AnimationFrameProvider](#) is a [DedicatedWorkerGlobalScope](#)

The [DedicatedWorkerGlobalScope](#)

Each [target object](#) has a *map of animation frame callbacks*, which is an [ordered map](#) that must be initially empty, and an *animation frame callback identifier*, which is a number that must initially be zero.

An [AnimationFrameProvider](#) provider is considered *supported* if any of the following hold:

- *provider* is a [Window](#).
- *provider*'s [owner set](#) contains a [Document](#) object.
- Any of the [DedicatedWorkerGlobalScope](#) objects in *provider*'s [owner set](#) are [supported](#).



[Window/requestAnimationFrame](#)

Support in all current engines.

---

Firefox 23+ Safari 7+ Chrome 24+

---

Opera 15+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 23+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 14+

The `requestAnimationFrame(callback)` method steps are:

1. If `this` is not supported, then throw a "[NotSupportedError](#)" [DOMException](#).
2. Let `target` be `this`'s [target object](#).
3. Increment `target`'s [animation frame callback identifier](#) by one, and let `handle` be the result.
4. Let `callbacks` be `target`'s [map of animation frame callbacks](#).
5. [Set](#) `callbacks[handle]` to `callback`.
6. Return `handle`.



## [Window/cancelAnimationFrame](#)

Support in all current engines.

Firefox 23+ Safari 7+ Chrome 24+

---

Opera 15+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 23+ Safari iOS 7+ Chrome Android 25+ WebView Android 37+ Samsung Internet 1.5+ Opera Android 14+

The `cancelAnimationFrame(handle)` method steps are:

1. If `this` is not supported, then throw a "[NotSupportedError](#)" [DOMException](#).
2. Let `callbacks` be `this`'s [target object](#)'s [map of animation frame callbacks](#).
3. [Remove](#) `callbacks[handle]`.

To run the animation frame callbacks for a [target object](#) target with a timestamp `now`:

1. Let `callbacks` be `target`'s [map of animation frame callbacks](#).
2. Let `callbackHandles` be the result of [getting the keys](#) of `callbacks`.
3. [For each](#) `handle` in `callbackHandles`, if `handle` [exists](#) in `callbacks`:
  1. Let `callback` be `callbacks[handle]`.
  2. [Remove](#) `callbacks[handle]`.

3. Invoke *callback*, passing *now* as the only argument, and if an exception is thrown, report the exception.

Inside workers, [requestAnimationFrame\(\)](#) can be used together with an [OffscreenCanvas](#) transferred from a [canvas](#) element. First, in the document, transfer control to the worker:

```
const offscreenCanvas = document.getElementById("c").transferControlToOffscreen();
worker.postMessage(offscreenCanvas, [offscreenCanvas]);
```

Then, in the worker, the following code will draw a rectangle moving from left to right:

```
let ctx, pos = 0;
function draw(dt) {
 ctx.clearRect(0, 0, 100, 100);
 ctx.fillRect(pos, 0, 10, 10);
 pos += 10 * dt;
 requestAnimationFrame(draw);
}

self.onmessage = function(ev) {
 const transferredCanvas = ev.data;
 ctx = transferredCanvas.getContext("2d");
 draw();
};
```

## 9 Communication

### 9.1 The [MessageEvent](#) interface



[MessageEvent](#)

Support in all current engines.

Firefox 4+ | Safari 4+ | Chrome 1+

---

Opera 10.6+ | Edge 79+

---

Edge (Legacy) 12+ | Internet Explorer 9+

---

Firefox | Android 4+ | Safari | iOS 3+ | Chrome | Android 18+ | WebView | Android 37+ | Samsung Internet 1.0+ | Opera | Android 11+

Messages in [server-sent events](#), [web sockets](#), [cross-document messaging](#), [channel messaging](#), and [broadcast channels](#) use the [MessageEvent](#) interface for their [message](#) events:

[Exposed=(Window,Worker,AudioWorklet)]

```
interface MessageEvent : Event {
 constructor(DOMString type, optional MessageEventInit eventInitDict = {});

 readonly attribute any data;
 readonly attribute USVString origin;
 readonly attribute DOMString lastEventId;
 readonly attribute MessageEventSource? source;
 readonly attribute FrozenArray<MessagePort> ports;

 undefined initMessageEvent(DOMString type, optional boolean bubbles = false);
};

dictionary MessageEventInit : EventInit {
 any data = null;
 USVString origin = "";
 DOMString lastEventId = "";
 MessageEventSource? source = null;
 sequence<MessagePort> ports = [];
};

typedef (WindowProxy or MessagePort or ServiceWorker) MessageEventSource;
```

### event.data

✓MDN

#### [MessageEvent/data](#)

Support in all current engines.

Firefox 4+ Safari 4+ Chrome 1+

---

Opera Yes Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android Yes Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android Yes

Returns the data of the message.

### event.origin

✓MDN

#### [MessageEvent/origin](#)

Support in all current engines.

Firefox 4+ Safari 4+ Chrome 1+

---

Opera Yes Edge 79+

Edge (Legacy)12+Internet Explorer9+

---

Firefox Android4+Safari iOS3+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera AndroidYes

Returns the origin of the message, for [server-sent events](#) and [cross-document messaging](#).

#### ***event.lastEventId***

✓MDN

[MessageEvent/lastEventId](#)

Support in all current engines.

Firefox4+Safari4+Chrome1+

---

OperaYesEdge79+

---

Edge (Legacy)17+Internet Explorer9+

---

Firefox AndroidYesSafari iOS3+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera AndroidYes

Returns the [last event ID string](#), for [server-sent events](#).

#### ***event.source***

✓MDN

[MessageEvent/source](#)

Support in all current engines.

Firefox55+Safari4+Chrome1+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet ExplorerNo

---

Firefox Android55+Safari iOS3+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns the [WindowProxy](#) of the source window, for [cross-document messaging](#), and the [MessagePort](#) being attached, in the [connect](#) event fired at [SharedWorkerGlobalScope](#) objects.

#### ***event.ports***

✓MDN

[MessageEvent/ports](#)

Support in all current engines.

Firefox4+Safari4+Chrome1+

---

OperaYesEdge79+

---

Edge (Legacy)12+Internet Explorer9+

---

Firefox AndroidYesSafari iOS3+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera AndroidYes

Returns the [MessagePort](#) array sent with the message, for [cross-document messaging](#) and [channel messaging](#).

The **data** attribute must return the value it was initialized to. It represents the message being sent.

The **origin** attribute must return the value it was initialized to. It represents, in [server-sent events](#) and [cross-document messaging](#), the [origin](#) of the document that sent the message (typically the scheme, hostname, and port of the document, but not its path or [fragment](#)).

The **lastEventId** attribute must return the value it was initialized to. It represents, in [server-sent events](#), the [last event ID string](#) of the event source.

The **source** attribute must return the value it was initialized to. It represents, in [cross-document messaging](#), the [WindowProxy](#) of the [browsing context](#) of the [Window](#) object from which the message came; and in the [connect](#) events used by [shared workers](#), the newly connecting [MessagePort](#).

The **ports** attribute must return the value it was initialized to. It represents, in [cross-document messaging](#) and [channel messaging](#), the [MessagePort](#) array being sent.

The **initMessageEvent(type, bubbles, cancelable, data, origin, lastEventId, source, ports)** method must initialize the event in a manner analogous to the similarly-named [initEvent\(\)](#) method. [\[DOM\]](#)

Various APIs (e.g., [WebSocket](#), [EventSource](#)) use the [MessageEvent](#) interface for their [message](#) event without using the [MessagePort](#) API.

## 9.2 Server-sent events



### [Server-sent events](#)

Support in all current engines.

Firefox6+Safari5+Chrome6+

---

Opera11+Edge79+

---

Edge (Legacy)NoInternet ExplorerNo

---

Firefox Android45+Safari iOS5+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android11+

### 9.2.1 Introduction

*This section is non-normative.*

To enable servers to push data to web pages over HTTP or using dedicated server-push protocols, this specification introduces the [EventSource](#) interface.

Using this API consists of creating an [EventSource](#) object and registering an event listener.

```
var source = new EventSource('updates.cgi');
source.onmessage = function (event) {
 alert(event.data);
};
```

On the server-side, the script ("updates.cgi" in this case) sends messages in the following form, with the [text/event-stream](#) MIME type:

```
data: This is the first message.

data: This is the second message, it
data: has two lines.

data: This is the third message.
```

---

Authors can separate events by using different event types. Here is a stream that has two event types, "add" and "remove":

```
event: add
data: 73857293

event: remove
data: 2153

event: add
data: 113411
```

The script to handle such a stream would look like this (where `addHandler` and `removeHandler` are functions that take one argument, the event):

```
var source = new EventSource('updates.cgi');
source.addEventListener('add', addHandler, false);
source.addEventListener('remove', removeHandler, false);
```

The default event type is "message".

Event streams are always decoded as UTF-8. There is no way to specify another character encoding.

---

Event stream requests can be redirected using HTTP 301 and 307 redirects as with normal HTTP requests. Clients will reconnect if the connection is closed; a client can be told to stop reconnecting using the HTTP 204 No Content response code.

Using this API rather than emulating it using [XMLHttpRequest](#) or an [iframe](#) allows the user agent to make better use of network resources in cases where the user agent implementer and the network operator are able to coordinate in advance. Amongst other benefits, this can result in significant savings in battery life on portable devices. This is discussed further in the section below on [connectionless push](#).

### 9.2.2 The [EventSource](#) interface



#### [EventSource](#)

Support in all current engines.

Firefox 6+ Safari 5+ Chrome 6+

Opera 11+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 4.5+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

```
[Exposed=(Window,Worker)]
interface EventSource : EventTarget {
 constructor(USVString url, optional EventSourceInit eventSourceInitDict = {}

 readonly attribute USVString url;
 readonly attribute boolean withCredentials;

 // ready state
 const unsigned short CONNECTING = 0;
 const unsigned short OPEN = 1;
 const unsigned short CLOSED = 2;
 readonly attribute unsigned short readyState;

 // networking
 attribute EventHandler onopen;
 attribute EventHandler onmessage;
 attribute EventHandler onerror;
 undefined close();
```

```
};

dictionary EventSourceInit {
 boolean withCredentials = false;
};
```

Each [EventSource](#) object has the following associated with it:

- A *url* (a [URL record](#)). Set during construction.
- A *request*. This must initially be null.
- A *reconnection time*, in milliseconds. This must initially be an [implementation-defined](#) value, probably in the region of a few seconds.
- A *last event ID string*. This must initially be the empty string.

Apart from *url* these are not currently exposed on the [EventSource](#) object.

**source = new EventSource( url [, { withCredentials: true } ] )**

✓MDN

## [EventSource/EventSource](#)

Support in all current engines.

Firefox6+Safari5+Chrome9+

---

Opera11+Edge79+

---

Edge (Legacy)NoInternet ExplorerNo

---

Firefox Android45+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12+

Creates a new [EventSource](#) object.

*url* is a string giving the [URL](#) that will provide the event stream.

Setting [withCredentials](#) to true will set the [credentials mode](#) for connection requests to *url* to "include".

**source.close()**

✓MDN

## [EventSource/close](#)

Support in all current engines.

Firefox6+Safari5+Chrome6+

---

Opera Yes Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 45+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12+

Aborts any instances of the [fetch](#) algorithm started for this [EventSource](#) object, and sets the [readyState](#) attribute to [CLOSED](#).

### **[source.url](#)**

✓MDN

#### [EventSource/url](#)

Support in all current engines.

---

Firefox 6+ Safari 5+ Chrome 6+

---

Opera Yes Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 45+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12+

Returns the [URL providing the event stream](#).

### **[source.withCredentials](#)**

✓MDN

#### [EventSource/withCredentials](#)

Support in all current engines.

---

Firefox 6+ Safari 5+ Chrome 6+

---

Opera Yes Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 45+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12+

Returns true if the [credentials mode](#) for connection requests to the [URL providing the event stream](#) is set to "include", and false otherwise.

### **[source.readyState](#)**

✓MDN

#### [EventSource/readystate](#)

Support in all current engines.

Firefox6+Safari5+Chrome6+

---

Opera Yes Edge79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android45+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12+

Returns the state of this [EventSource](#) object's connection. It can have the values described below.

The *EventSource(url, eventSourceInitDict)* constructor, when invoked, must run these steps:

1. Let ev be a new [EventSource](#) object.
2. Let settings be ev's [relevant settings object](#).
3. Let urlRecord be the result of [parsing url](#) with settings's [API base URL](#) and settings's [API URL character encoding](#).
4. If urlRecord is failure, then throw a "[SyntaxError](#)" [DOMException](#).
5. Set ev's [url](#) to urlRecord.
6. Let corsAttributeState be [Anonymous](#).
7. If the value of eventSourceInitDict's [withCredentials](#) member is true, then set corsAttributeState to [Use Credentials](#) and set ev's [withCredentials](#) attribute to true.
8. Let request be the result of [creating a potential-CORS request](#) given urlRecord, the empty string, and corsAttributeState.
9. Set request's [client](#) to settings.
10. User agents may [set \('Accept', 'text/event-stream'\)](#) in request's [header list](#).
11. Set request's [cache mode](#) to "no-store".
12. Set ev's [request](#) to request.
13. Run this step [in parallel](#):
  1. [Fetch request](#).
14. Return ev.

---

The *url* attribute's getter must return the [serialization](#) of this [EventSource](#) object's [url](#).

The `withCredentials` attribute must return the value to which it was last initialized. When the object is created, it must be initialized to false.

The `readyState` attribute represents the state of the connection. It can have the following values:

**CONNECTING** (numeric value 0)

The connection has not yet been established, or it was closed and the user agent is reconnecting.

**OPEN** (numeric value 1)

The user agent has an open connection and is dispatching events as it receives them.

**CLOSED** (numeric value 2)

The connection is not open, and the user agent is not trying to reconnect. Either there was a fatal error or the `close()` method was invoked.

When the object is created its `readyState` must be set to **CONNECTING** (0). The rules given below for handling the connection define when the value changes.

The `close()` method must abort any instances of the `fetch` algorithm started for this `EventSource` object, and must set the `readyState` attribute to **CLOSED**.

The following are the `event handlers` (and their corresponding `event handler event types`) that must be supported, as `event handler IDL attributes`, by all objects implementing the `EventSource` interface:

	<u>Event handler</u>	<u>Event handler event type</u>
<code>onopen</code>		
	 MDN	
<a href="#">EventSource/onopen</a>		
Support in all current engines.		<a href="#">open</a>
Firefox 6+ Safari 5+ Chrome 6+		
Opera Yes Edge 79+		
Edge (Legacy) No Internet Explorer No		
Firefox Android 45+ Safari iOS 5+ Chrome Android 18+ WebView		
Android 37+ Samsung Internet 1.0+ Opera Android 12+		
<code>onmessage</code>		
	 MDN	
<a href="#">EventSource/onmessage</a>		<a href="#">message</a>

## [Event handler](#)

## [Event handler event type](#)

Support in all current engines.

Firefox6+Safari5+Chrome6+

Opera Yes Edge79+

Edge (Legacy) No Internet Explorer No

Firefox Android45+Safari iOS5+Chrome Android18+WebView

Android37+Samsung Internet1.0+Opera Android12+

*onerror*



## [EventSource/onerror](#)

Support in all current engines.

[error](#)

Firefox6+Safari5+Chrome6+

Opera Yes Edge79+

Edge (Legacy) No Internet Explorer No

Firefox Android45+Safari iOS5+Chrome Android18+WebView

Android37+Samsung Internet1.0+Opera Android12+

### 9.2.3 Processing model

The resource indicated in the argument to the [EventSource](#) constructor is fetched when the constructor is run.

As data is received, the [tasks](#) queued by the [networking task source](#) to handle the data must act as follows.

HTTP 200 OK responses with a '[Content-Type](#)' header specifying the type '[text/event-stream](#)', ignoring any [MIME type](#) parameters, must be processed line by line [as described below](#).

When a successful response with a supported [MIME type](#) is received, such that the user agent begins parsing the contents of the stream, the user agent must [announce the connection](#).

The [task](#) that the [networking task source](#) places on the [task queue](#) once fetching for such a resource (with the correct [MIME type](#)) has completed must cause the user agent to [reestablish the connection in parallel](#). This applies whether the connection is closed gracefully or unexpectedly (but does not apply when fetching is canceled by the user agent, e.g., in response to [window.stop\(\)](#), since in those cases the final [task](#) is actually discarded). It doesn't apply for the error conditions listed below except where explicitly specified.

HTTP 200 OK responses that have a [Content-Type](#) specifying an unsupported type, or that have no [Content-Type](#) at all, must cause the user agent to [fail the connection](#).

Network errors that prevents the connection from being established in the first place (e.g. DNS errors), should cause the user agent to [reestablish the connection in parallel](#), unless the user agent knows that to be futile, in which case the user agent may [fail the connection](#).

Any other HTTP response code not listed here, as well as the cancelation of the fetch algorithm by the user agent (e.g. in response to [window.stop\(\)](#) or the user canceling the network connection manually) must cause the user agent to [fail the connection](#).

---

When a user agent is to *announce the connection*, the user agent must [queue a task](#) which, if the [readyState](#) attribute is set to a value other than [CLOSED](#), sets the [readyState](#) attribute to [OPEN](#) and [fires an event](#) named [open](#) at the [EventSource](#) object.

When a user agent is to *reestablish the connection*, the user agent must run the following steps. These steps are run [in parallel](#), not as part of a [task](#). (The tasks that it queues, of course, are run like normal tasks and not themselves [in parallel](#).)

1. [Queue a task](#) to run the following steps:

1. If the [readyState](#) attribute is set to [CLOSED](#), abort the task.
2. Set the [readyState](#) attribute to [CONNECTING](#).
3. [Fire an event](#) named [error](#) at the [EventSource](#) object.

2. Wait a delay equal to the reconnection time of the event source.

3. Optionally, wait some more. In particular, if the previous attempt failed, then user agents might introduce an exponential backoff delay to avoid overloading a potentially already overloaded server. Alternatively, if the operating system has reported that there is no network connectivity, user agents might wait for the operating system to announce that the network connection has returned before retrying.

4. Wait until the aforementioned task has run, if it has not yet run.

5. [Queue a task](#) to run the following steps:

1. If the [EventSource](#) object's [readyState](#) attribute is not set to [CONNECTING](#), then return.
2. Let *request* be the [EventSource](#) object's [request](#).
3. If the [EventSource](#) object's [last event ID string](#) is not the empty string, then:
  1. Let *lastEventIDValue* be the [EventSource](#) object's [last event ID string](#),

[encoded as UTF-8.](#)

2. Set ('[Last-Event-ID](#)', *lastEventIDValue*) in *request's header list*.
4. [Fetch](#) *request* and process the response obtained in this fashion, if any, as described earlier in this section.

When a user agent is to *fail the connection*, the user agent must [queue a task](#) which, if the [readyState](#) attribute is set to a value other than [CLOSED](#), sets the [readyState](#) attribute to [CLOSED](#) and [fires an event](#) named [error](#) at the [EventSource](#) object. Once the user agent has [failed the connection](#), it does *not attempt to reconnect*.

---

The [task source](#) for any [tasks](#) that are [queued](#) by [EventSource](#) objects is the *remote event task source*.

#### 9.2.4 The '[Last-Event-ID](#)' header

The *Last-Event-ID* HTTP request header reports an [EventSource](#) object's [last event ID string](#) to the server when the user agent is to [reestablish the connection](#).

See [whatwg/html issue #7363](#) to define the value space better. It is essentially any UTF-8 encoded string, that does not contain U+0000 NULL, U+000A LF, or U+000D CR.

#### 9.2.5 Parsing an event stream

This event stream format's [MIME type](#) is [text/event-stream](#).

The event stream format is as described by the [stream](#) production of the following ABNF, the character set for which is Unicode. [\[ABNF\]](#)

```
stream = [bom] *event
event = *(comment / field) end-of-line
comment = colon *any-char end-of-line
field = 1*name-char [colon [space] *any-char] end-of-line
end-of-line = (cr lf / cr / lf)

; characters
lf = %x000A ; U+000A LINE FEED (LF)
cr = %x000D ; U+000D CARRIAGE RETURN (CR)
space = %x0020 ; U+0020 SPACE
colon = %x003A ; U+003A COLON (:)
bom = %xFEFF ; U+FEFF BYTE ORDER MARK
name-char = %x0000-0009 / %x000B-000C / %x000E-0039 / %x003B-10FFFF
 ; a scalar value other than U+000A LINE FEED (LF), U+000D CARRIAGE RETURN (CR)
any-char = %x0000-0009 / %x000B-000C / %x000E-10FFFF
 ; a scalar value other than U+000A LINE FEED (LF) or U+000D CARRIAGE RETURN (CR)
```

Event streams in this format must always be encoded as UTF-8. [\[ENCODING\]](#)

Lines must be separated by either a U+000D CARRIAGE RETURN U+000A LINE FEED (CRLF) character pair, a single U+000A LINE FEED (LF) character, or a single U+000D CARRIAGE RETURN (CR) character.

Since connections established to remote servers for such resources are expected to be long-lived, UAs should ensure that appropriate buffering is used. In particular, while line buffering with lines are defined to end with a single U+000A LINE FEED (LF) character is safe, block buffering or line buffering with different expected line endings can cause delays in event dispatch.

#### 9.2.6 Interpreting an event stream

Streams must be decoded using the [UTF-8 decode](#) algorithm.

The [UTF-8 decode](#) algorithm strips one leading UTF-8 Byte Order Mark (BOM), if any.

The stream must then be parsed by reading everything line by line, with a U+000D CARRIAGE RETURN U+000A LINE FEED (CRLF) character pair, a single U+000A LINE FEED (LF) character not preceded by a U+000D CARRIAGE RETURN (CR) character, and a single U+000D CARRIAGE RETURN (CR) character not followed by a U+000A LINE FEED (LF) character being the ways in which a line can end.

When a stream is parsed, a *data* buffer, an *event type* buffer, and a *last event ID* buffer must be associated with it. They must be initialized to the empty string.

Lines must be processed, in the order they are received, as follows:

If the line is empty (a blank line)

[Dispatch the event](#), as defined below.

If the line starts with a U+003A COLON character (:)

Ignore the line.

If the line contains a U+003A COLON character (:)

Collect the characters on the line before the first U+003A COLON character (:), and let *field* be that string.

Collect the characters on the line after the first U+003A COLON character (:), and let *value* be that string. If *value* starts with a U+0020 SPACE character, remove it from *value*.

[Process the field](#) using the steps described below, using *field* as the field name and *value* as the field value.

Otherwise, the string is not empty but does not contain a U+003A COLON character (:)

[Process the field](#) using the steps described below, using the whole line as the field name, and the empty string as the field value.

Once the end of the file is reached, any pending data must be discarded. (If the file ends in the middle of an event, before the final empty line, the incomplete event is not dispatched.)

---

The steps to *process the field* given a field name and a field value depend on the field name, as given in the following list. Field names must be compared literally, with no case folding performed.

If the field name is "event"

Set the *event type* buffer to field value.

If the field name is "data"

Append the field value to the *data* buffer, then append a single U+000A LINE FEED (LF) character to the *data* buffer.

If the field name is "id"

If the field value does not contain U+0000 NULL, then set the *last event ID* buffer to the field value. Otherwise, ignore the field.

If the field name is "retry"

If the field value consists of only [ASCII digits](#), then interpret the field value as an integer in base ten, and set the event stream's [reconnection time](#) to that integer. Otherwise, ignore the field.

Otherwise

The field is ignored.

When the user agent is required to *dispatch the event*, the user agent must process the *data* buffer, the *event type* buffer, and the *last event ID* buffer using steps appropriate for the user agent.

For web browsers, the appropriate steps to [dispatch the event](#) are as follows:

1. Set the [last event ID string](#) of the event source to the value of the *last event ID* buffer. The buffer does not get reset, so the [last event ID string](#) of the event source remains set to this value until the next time it is set by the server.
2. If the *data* buffer is an empty string, set the *data* buffer and the *event type* buffer to the

empty string and return.

3. If the *data* buffer's last character is a U+000A LINE FEED (LF) character, then remove the last character from the *data* buffer.
4. Let *event* be the result of [creating an event](#) using [MessageEvent](#), in the [relevant Realm](#) of the [EventSource](#) object.
5. Initialize *event*'s [type](#) attribute to [message](#), its [data](#) attribute to *data*, its [origin](#) attribute to the [serialization](#) of the [origin](#) of the event stream's final URL (i.e., the URL after redirects), and its [lastEventId](#) attribute to the [last event ID string](#) of the event source.
6. If the *event type* buffer has a value other than the empty string, change the [type](#) of the newly created event to equal the value of the *event type* buffer.
7. Set the *data* buffer and the *event type* buffer to the empty string.
8. [Queue a task](#) which, if the [readyState](#) attribute is set to a value other than [CLOSED](#), [dispatches](#) the newly created event at the [EventSource](#) object.

If an event doesn't have an "id" field, but an earlier event did set the event source's [last event ID string](#), then the event's [lastEventId](#) field will be set to the value of whatever the last seen "id" field was.

For other user agents, the appropriate steps to [dispatch the event](#) are implementation dependent, but at a minimum they must set the *data* and *event type* buffers to the empty string before returning.

The following event stream, once followed by a blank line:

```
data: YH00
data: +2
data: 10
```

...would cause an event [message](#) with the interface [MessageEvent](#) to be dispatched on the [EventSource](#) object. The event's [data](#) attribute would contain the string "YH00\n+2\n10" (where "\n" represents a newline).

This could be used as follows:

```
var stocks = new EventSource("https://stocks.example.com/ticker.php");
stocks.onmessage = function (event) {
 var data = event.data.split('\n');
 updateStocks(data[0], data[1], data[2]);
};
```

...where `updateStocks()` is a function defined as:

```
function updateStocks(symbol, delta, value) { ... }
```

...or some such.

The following stream contains four blocks. The first block has just a comment, and will fire nothing. The second block has two fields with names "data" and "id" respectively; an event will be fired for this block, with the data "first event", and will then set the last event ID to "1" so that if the connection died between this block and the next, the server would be sent a '[Last-Event-ID](#)' header with the value '1'. The third block fires an event with data "second event", and also has an "id" field, this time with no value, which resets the last event ID to the empty string (meaning no '[Last-Event-ID](#)' header will now be sent in the event of a reconnection being attempted). Finally, the last block just fires an event with the data " third event" (with a single leading space character). Note that the last still has to end with a blank line, the end of the stream is not enough to trigger the dispatch of the last event.

```
: test stream
```

```
data: first event
id: 1
```

```
data:second event
id
```

```
data: third event
```

The following stream fires two events:

```
data
```

```
data
data
```

```
data:
```

The first block fires events with the data set to the empty string, as would the last block if it was followed by a blank line. The middle block fires an event with the data set to a single newline character. The last block is discarded because it is not followed by a blank line.

The following stream fires two identical events:

```
data:test
```

```
data: test
```

This is because the space after the colon is ignored if present.

### 9.2.7 Authoring notes

Legacy proxy servers are known to, in certain cases, drop HTTP connections after a short timeout. To protect against such proxy servers, authors can include a comment line (one starting with a ':' character) every 15 seconds or so.

Authors wishing to relate event source connections to each other or to specific documents previously served might find that relying on IP addresses doesn't work, as individual clients can have multiple IP addresses (due to having multiple proxy servers) and individual IP addresses can have multiple clients (due to sharing a proxy server). It is better to include a unique identifier in the document when it is served and then pass that identifier as part of the URL when the connection is established.

Authors are also cautioned that HTTP chunking can have unexpected negative effects on the reliability of this protocol, in particular if the chunking is done by a different layer unaware of the timing requirements. If this is a problem, chunking can be disabled for serving event streams.

Clients that support HTTP's per-server connection limitation might run into trouble when opening multiple pages from a site if each page has an [EventSource](#) to the same domain. Authors can avoid this using the relatively complex mechanism of using unique domain names per connection, or by allowing the user to enable or disable the [EventSource](#) functionality on a per-page basis, or by sharing a single [EventSource](#) object using a [shared worker](#).

### 9.2.8 Connectionless push and other features

User agents running in controlled environments, e.g. browsers on mobile handsets tied to specific carriers, may offload the management of the connection to a proxy on the network. In such a situation, the user agent for the purposes of conformance is considered to include both the handset software and the network proxy.

For example, a browser on a mobile device, after having established a connection, might detect that it is on a supporting network and request that a proxy server on the network take over the management of the connection. The timeline for such a situation might be as follows:

1. Browser connects to a remote HTTP server and requests the resource specified by the author in the [EventSource](#) constructor.
2. The server sends occasional messages.
3. In between two messages, the browser detects that it is idle except for the network activity involved in keeping the TCP connection alive, and decides to switch to sleep mode to save power.
4. The browser disconnects from the server.
5. The browser contacts a service on the network, and requests that the service, a "push proxy", maintain the connection instead.
6. The "push proxy" service contacts the remote HTTP server and requests the resource specified by the author in the [EventSource](#) constructor (possibly including a '[Last-Event-ID](#)' HTTP header, etc.).

7. The browser allows the mobile device to go to sleep.
8. The server sends another message.
9. The "push proxy" service uses a technology such as OMA push to convey the event to the mobile device, which wakes only enough to process the event and then returns to sleep.

This can reduce the total data usage, and can therefore result in considerable power savings.

As well as implementing the existing API and [text/event-stream](#) wire format as defined by this specification and in more distributed ways as described above, formats of event framing defined by [other applicable specifications](#) may be supported. This specification does not define how they are to be parsed or processed.

#### 9.2.9 Garbage collection

While an [EventSource](#) object's [readyState](#) is [CONNECTING](#), and the object has one or more event listeners registered for [open](#), [message](#) or [error](#) events, there must be a strong reference from the [Window](#) or [WorkerGlobalScope](#) object that the [EventSource](#) object's constructor was invoked from to the [EventSource](#) object itself.

While an [EventSource](#) object's [readyState](#) is [OPEN](#), and the object has one or more event listeners registered for [message](#) or [error](#) events, there must be a strong reference from the [Window](#) or [WorkerGlobalScope](#) object that the [EventSource](#) object's constructor was invoked from to the [EventSource](#) object itself.

While there is a task queued by an [EventSource](#) object on the [remote event task source](#), there must be a strong reference from the [Window](#) or [WorkerGlobalScope](#) object that the [EventSource](#) object's constructor was invoked from to that [EventSource](#) object.

If a user agent is to *forcibly close* an [EventSource](#) object (this happens when a [Document](#) object goes away permanently), the user agent must abort any instances of the [fetch](#) algorithm started for this [EventSource](#) object, and must set the [readyState](#) attribute to [CLOSED](#).

If an [EventSource](#) object is garbage collected while its connection is still open, the user agent must abort any instance of the [fetch](#) algorithm opened by this [EventSource](#).

#### 9.2.10 Implementation advice

*This section is non-normative.*

User agents are strongly urged to provide detailed diagnostic information about [EventSource](#) objects and their related network connections in their development consoles, to aid authors in debugging code using this API.

For example, a user agent could have a panel displaying all the [EventSource](#) objects a page has created, each listing the constructor's arguments, whether there was a network error, what

the CORS status of the connection is and what headers were sent by the client and received from the server to lead to that status, the messages that were received and how they were parsed, and so forth.

Implementations are especially encouraged to report detailed information to their development consoles whenever an [error](#) event is fired, since little to no information can be made available in the events themselves.

## 9.3 Web sockets

### 9.3.1 Introduction

*This section is non-normative.*

To enable web applications to maintain bidirectional communications with server-side processes, this specification introduces the [WebSocket](#) interface.

This interface does not allow for raw access to the underlying network. For example, this interface could not be used to implement an IRC client without proxying messages through a custom server.

### 9.3.2 The [WebSocket](#) interface



#### [WebSocket](#)

Support in all current engines.

---

Firefox 11+ Safari 5+ Chrome 4+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 14+ Safari iOS 4.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

```
enum BinaryType { "blob", "arraybuffer" };
[Exposed=(Window,Worker)]
interface WebSocket : EventTarget {
 constructor(USVString url, optional (DOMString or sequence<DOMString>) protocols);
 readonly attribute USVString url;
 // ready state
 const unsigned short CONNECTING = 0;
 const unsigned short OPEN = 1;
 const unsigned short CLOSING = 2;
```

```

const unsigned short CLOSED = 3;
readonly attribute unsigned short readyState;
readonly attribute unsigned long long bufferedAmount;

// networking
attribute EventHandler onopen;
attribute EventHandler onerror;
attribute EventHandler onclose;
readonly attribute DOMString extensions;
readonly attribute DOMString protocol;
undefined close(optional [Clamp] unsigned short code, optional USVString rea

// messaging
attribute EventHandler onmessage;
attribute BinaryType binaryType;
undefined send(USVString data);
undefined send(Blob data);
undefined send(ArrayBuffer data);
undefined send(ArrayBufferView data);
};


```

Each [WebSocket](#) object has an associated *url* (a [URL record](#)).

**socket = new [WebSocket\(url \[, protocols \]\)](#)**

✓MDN

## [WebSocket/WebSocket](#)

Support in all current engines.

Firefox 11+ Safari 5+ Chrome 4+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 14+ Safari iOS 4.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Creates a new [WebSocket](#) object, immediately establishing the associated WebSocket connection.

*url* is a string giving the [URL](#) over which the connection is established. Only "ws" or "wss" schemes are allowed; others will cause a ["SyntaxError" DOMException](#). URLs with [fragments](#) will also cause such an exception.

*protocols* is either a string or an array of strings. If it is a string, it is equivalent to an array consisting of just that string; if it is omitted, it is equivalent to the empty array. Each string in the array is a subprotocol name. The connection will only be established if the server

reports that it has selected one of these subprotocols. The subprotocol names have to match the requirements for elements that comprise the value of [Sec-WebSocket-Protocol](#) fields as defined by *The WebSocket protocol*. [\[WSP\]](#)

### **`socket.send(data)`**

✓MDN

#### [WebSocket/send](#)

Support in all current engines.

Firefox 18+ Safari 5+ Chrome 4+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 18+ Safari iOS 4.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Transmits *data* using the WebSocket connection. *data* can be a string, a [Blob](#), an [ArrayBuffer](#), or an [ArrayBufferView](#).

### **`socket.close([ code ] [, reason ])`**

✓MDN

#### [WebSocket/close](#)

Support in all current engines.

Firefox 7+ Safari 5+ Chrome 4+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 7+ Safari iOS 4.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

Closes the WebSocket connection, optionally using *code* as [the WebSocket connection close code](#) and *reason* as the [the WebSocket connection close reason](#).

### **`socket.url`**

✓MDN

#### [WebSocket/url](#)

Support in all current engines.

Firefox 7+ Safari 6+ Chrome 18+

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet ExplorerNo

---

Firefox Android7+Safari iOS6+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns the [URL that was used](#) to establish the WebSocket connection.

### **`socket.readyState`**

✓MDN

[WebSocket/readyState](#)

Support in all current engines.

Firefox7+Safari5+Chrome4+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android7+Safari iOS4.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns the state of the [WebSocket](#) object's connection. It can have the values described below.

### **`socket.bufferedAmount`**

✓MDN

[WebSocket/bufferedAmount](#)

Support in all current engines.

Firefox7+Safari5+Chrome4+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android7+Safari iOS4.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

Returns the number of bytes of application data (UTF-8 text and binary data) that have been queued using [send\(\)](#) but not yet been transmitted to the network.

If the WebSocket connection is closed, this attribute's value will only increase with each call to the [send\(\)](#) method. (The number does not reset to zero once the connection closes.)

### **`socket.extensions`**

✓MDN

[WebSocket/extensions](#)

Support in all current engines.

Firefox 8+ Safari 6+ Chrome 16+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 8+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung

---

Internet 1.0+ Opera Android 12.1+

Returns the extensions selected by the server, if any.

### **`socket.protocol`**

✓MDN

#### [WebSocket/protocol](#)

Support in all current engines.

Firefox 7+ Safari 6+ Chrome 15+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer No

---

Firefox Android 7+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung

---

Internet 1.0+ Opera Android 12.1+

Returns the subprotocol selected by the server, if any. It can be used in conjunction with the array form of the constructor's second argument to perform subprotocol negotiation.

### **`socket.binaryType [ = value ]`**

✓MDN

#### [WebSocket/binaryType](#)

Support in all current engines.

Firefox 11+ Safari 6+ Chrome 15+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 14+ Safari iOS 6+ Chrome Android 18+ WebView Android 37+ Samsung

---

Internet 1.0+ Opera Android 12.1+

Returns a string that indicates how binary data from the [WebSocket](#) object is exposed to scripts:

**"blob"**

Binary data is returned in [Blob](#) form.

## ["arraybuffer"](#)

Binary data is returned in [ArrayBuffer](#) form.

Can be set, to change how binary data is returned. The default is "[blob](#)".

The `new WebSocket(url, protocols)` constructor steps are:

1. Let `urlRecord` be the result of applying the [URL parser](#) to `url`.
2. If `urlRecord` is failure, then throw a ["SyntaxError" DOMException](#).
3. If `urlRecord`'s `scheme` is not "ws" or "wss", then throw a ["SyntaxError" DOMException](#).
4. If `urlRecord`'s `fragment` is non-null, then throw a ["SyntaxError" DOMException](#).
5. If `protocols` is a string, set `protocols` to a sequence consisting of just that string.
6. If any of the values in `protocols` occur more than once or otherwise fail to match the requirements for elements that comprise the value of [Sec-WebSocket-Protocol](#) fields as defined by *The WebSocket protocol*, then throw a ["SyntaxError" DOMException](#). [\[WSP\]](#)
7. Set `this`'s `url` to `urlRecord`.
8. Let `client` be `this`'s [relevant settings object](#).
9. Run this step [in parallel](#):
  1. Establish a [WebSocket connection](#) given `urlRecord`, `protocols`, and `client`.  
[\[FETCH\]](#)

If the [establish a WebSocket connection](#) algorithm fails, it triggers the [fail the WebSocket connection](#) algorithm, which then invokes the [close the WebSocket connection](#) algorithm, which then establishes that [the WebSocket connection is closed](#), which fires the [close](#) event [as described below](#).

---

The `url` attribute's getter must return this [WebSocket](#) object's `url`, [serialized](#).

The `readyState` attribute represents the state of the connection. It can have the following values:

### **CONNECTING** (numeric value 0)

The connection has not yet been established.

***OPEN*** (numeric value 1)

*The WebSocket connection is established* and communication is possible.

***CLOSING*** (numeric value 2)

The connection is going through the closing handshake, or the [`close\(\)`](#) method has been invoked.

***CLOSED*** (numeric value 3)

The connection has been closed or could not be opened.

When the object is created its [`readyState`](#) must be set to ***CONNECTING*** (0).

The `extensions` attribute must initially return the empty string. After *the WebSocket connection is established*, its value might change, as defined below.

The `protocol` attribute must initially return the empty string. After *the WebSocket connection is established*, its value might change, as defined below.

The `close(code, reason)` method, when invoked, must run these steps:

1. If *code* is present, but is neither an integer equal to 1000 nor an integer in the range 3000 to 4999, inclusive, throw an [`"InvalidAccessError"` DOMException](#).
2. If *reason* is present, then run these substeps:
  1. Let *reasonBytes* be the result of [`encoding`](#) *reason*.
  2. If *reasonBytes* is longer than 123 bytes, then throw a [`"SyntaxError"` DOMException](#).
3. Run the first matching steps from the following list:

If the [`readyState`](#) attribute is in the ***CLOSING*** (2) or ***CLOSED*** (3) state

Do nothing.

The connection is already closing or is already closed. If it has not already, a [`close`](#) event will eventually fire [as described below](#).

If the WebSocket connection is not yet [`established` \[WSP\]](#)

*Fail the WebSocket connection* and set the [`readyState`](#) attribute's value to ***CLOSING*** (2). [\[WSP\]](#)

The [`fail the WebSocket connection`](#) algorithm invokes the [`close the WebSocket connection`](#) algorithm, which then establishes that *the WebSocket connection is closed*, which fires the [`close`](#) event [as described below](#).

If the WebSocket closing handshake has not yet been [started](#) [WSP]

[Start the WebSocket closing handshake](#) and set the `readyState` attribute's value to `CLOSING` (2). [WSP]

If neither `code` nor `reason` is present, the WebSocket Close message must not have a body.

*WebSocket Protocol* erroneously states that the status code is required for the [start the WebSocket closing handshake](#) algorithm.

If `code` is present, then the status code to use in the WebSocket Close message must be the integer given by `close`. [WSP]

If `reason` is also present, then `reasonBytes` must be provided in the Close message after the status code. [WSP]

The [start the WebSocket closing handshake](#) algorithm eventually invokes the [close the WebSocket connection](#) algorithm, which then establishes that [the WebSocket connection is closed](#), which fires the `close` event [as described below](#).

Otherwise

Set the `readyState` attribute's value to `CLOSING` (2).

[The WebSocket closing handshake is started](#), and will eventually invoke the [close the WebSocket connection](#) algorithm, which will establish that [the WebSocket connection is closed](#), and thus the `close` event will fire, [as described below](#).

The `close()` method does not discard previously sent messages before starting the WebSocket closing handshake — even if, in practice, the user agent is still busy sending those messages, the handshake will only start after the messages are sent.

---

The `bufferedAmount` attribute must return the number of bytes of application data (UTF-8 text and binary data) that have been queued using `send()` but that, as of the last time the `event loop` reached [step 1](#), had not yet been transmitted to the network. (This thus includes any text sent during the execution of the current task, regardless of whether the user agent is able to transmit text in the background [in parallel](#) with script execution.) This does not include framing overhead incurred by the protocol, or buffering done by the operating system or network hardware.

In this simple example, the `bufferedAmount` attribute is used to ensure that updates are sent either at the rate of one update every 50ms, if the network can handle that rate, or at whatever rate the network *can* handle, if that is too fast.

```
var socket = new WebSocket('ws://game.example.com:12010/updates');
```

```
socket.onopen = function () {
 setInterval(function() {
 if (socket.bufferedAmount == 0)
 socket.send(getUpdateData());
 }, 50);
};
```

The [bufferedAmount](#) attribute can also be used to saturate the network without sending the data at a higher rate than the network can handle, though this requires more careful monitoring of the value of the attribute over time.

---

When a [WebSocket](#) object is created, its [\*binaryType\*](#) IDL attribute must be set to the string "[blob](#)". On getting, it must return the last value it was set to. On setting, the user agent must set the IDL attribute to the new value.

User agents can use the [\*binaryType\*](#) attribute as a hint for how to handle incoming binary data: if the attribute is set to "[blob](#)", it is safe to spool it to disk, and if it is set to "[arraybuffer](#)", it is likely more efficient to keep the data in memory. Naturally, user agents are encouraged to use more subtle heuristics to decide whether to keep incoming data in memory or not, e.g. based on how big the data is or how common it is for a script to change the attribute at the last minute. This latter aspect is important in particular because it is quite possible for the attribute to be changed after the user agent has received the data but before the user agent has fired the event for it.

The [\*send\(data\)\*](#) method transmits data using the connection. If the [\*readyState\*](#) attribute is [CONNECTING](#), it must throw an "[InvalidStateError](#)" [DOMException](#). Otherwise, the user agent must run the appropriate set of steps from the following list:

If the argument is a string

If [the WebSocket connection is established](#) and [the WebSocket closing handshake has not yet started](#), then the user agent must [send a WebSocket Message](#) comprised of the *data* argument using a text frame opcode; if the data cannot be sent, e.g. because it would need to be buffered but the buffer is full, the user agent must [flag the WebSocket as full](#) and then [close the WebSocket connection](#). Any invocation of this method with a string argument that does not throw an exception must increase the [bufferedAmount](#) attribute by the number of bytes needed to express the argument as UTF-8. [\[UNICODE\]](#) [\[ENCODING\]](#) [\[WSP\]](#)

If the argument is a [Blob](#) object

If [the WebSocket connection is established](#), and [the WebSocket closing handshake has not yet started](#), then the user agent must [send a WebSocket Message](#) comprised of *data* using a binary frame opcode; if the data cannot be sent, e.g. because it would need to be buffered but the buffer is full, the user agent must [flag the WebSocket as full](#) and then [close the WebSocket connection](#). The data to be sent is the raw data represented by the [Blob](#) object.

Any invocation of this method with a [Blob](#) argument that does not throw an exception must increase the [bufferedAmount](#) attribute by the size of the [Blob](#) object's raw data, in bytes. [\[WSP\]](#) [\[FILEAPI\]](#)

If the argument is an [ArrayBuffer](#) object

If [the WebSocket connection is established](#), and [the WebSocket closing handshake has not yet started](#), then the user agent must [send a WebSocket Message](#) comprised of *data* using a binary frame opcode; if the data cannot be sent, e.g. because it would need to be buffered but the buffer is full, the user agent must [flag the WebSocket as full](#) and then [close the WebSocket connection](#). The data to be sent is the data stored in the buffer described by the [ArrayBuffer](#) object. Any invocation of this method with an [ArrayBuffer](#) argument that does not throw an exception must increase the [bufferedAmount](#) attribute by the length of the [ArrayBuffer](#) in bytes. [\[WSP\]](#)

If the argument is an object that matches the [ArrayBufferView](#) type definition

If [the WebSocket connection is established](#), and [the WebSocket closing handshake has not yet started](#), then the user agent must [send a WebSocket Message](#) comprised of *data* using a binary frame opcode; if the data cannot be sent, e.g. because it would need to be buffered but the buffer is full, the user agent must [flag the WebSocket as full](#) and then [close the WebSocket connection](#). The data to be sent is the data stored in the section of the buffer described by the [ArrayBuffer](#) object that *data* references. Any invocation of this method with this kind of argument that does not throw an exception must increase the [bufferedAmount](#) attribute by the length of *data*'s buffer in bytes. [\[WSP\]](#)

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the [WebSocket](#) interface:

	<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
<a href="#">onopen</a>	<a href="#">MDN</a>	<a href="#">open</a>
<a href="#">WebSocket/onopen</a>		
Support in all current engines.		
Firefox 7+ Safari 5+ Chrome 4+		
Opera 12.1+ Edge 79+		
Edge (Legacy) 12+ Internet Explorer 10+		
Firefox Android 7+ Safari iOS 4.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+		
<a href="#">onmessage</a>		<a href="#">message</a>

## [Event handler](#)

[Event handler](#)  
[event type](#)



### [WebSocket/onmessage](#)

Support in all current engines.

Firefox 7+ Safari 5+ Chrome 4+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 7+ Safari iOS 4.2+ Chrome Android 18+ WebView

Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

*onerror*



### [WebSocket/onerror](#)

Support in all current engines.

[error](#)

Firefox 7+ Safari 5+ Chrome 5+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 7+ Safari iOS 4.2+ Chrome Android 18+ WebView

Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

*onclose*



### [WebSocket/onclose](#)

Support in all current engines.

[close](#)

Firefox 7+ Safari 5+ Chrome 4+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 7+ Safari iOS 4.2+ Chrome Android 18+ WebView

Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

### 9.3.3 Feedback from the protocol

When [\*the WebSocket connection is established\*](#), the user agent must [queue a task](#) to run these steps:

1. Change the [readyState](#) attribute's value to [OPEN](#) (1).

2. Change the [extensions](#) attribute's value to the [extensions in use](#), if it is not the null value. [WSP]
3. Change the [protocol](#) attribute's value to the [subprotocol in use](#), if it is not the null value. [WSP]
4. [Fire an event](#) named [open](#) at the [WebSocket](#) object.

Since the algorithm above is [queued as a task](#), there is no race condition between [the WebSocket connection being established](#) and the script setting up an event listener for the [open](#) event.

---

When [a WebSocket message has been received](#) with type [type](#) and data [data](#), the user agent must [queue a task](#) to follow these steps: [WSP]

1. If the [readyState](#) attribute's value is not [OPEN](#) (1), then return.
2. Let [dataForEvent](#) be determined by switching on [type](#) and [binaryType](#):
  - [type](#) indicates that the data is Text
    - a new [DOMString](#) containing [data](#)
  - [type](#) indicates that the data is Binary and [binaryType](#) is "[blob](#)"
    - a new [Blob](#) object, created in the [relevant Realm](#) of the [WebSocket](#) object, that represents [data](#) as its raw data [FILEAPI]
  - [type](#) indicates that the data is Binary and [binaryType](#) is "[arraybuffer](#)"
    - a new [ArrayBuffer](#) object, created in the [relevant Realm](#) of the [WebSocket](#) object, whose contents are [data](#)
3. [Fire an event](#) named [message](#) at the [WebSocket](#) object, using [MessageEvent](#), with the [origin](#) attribute initialized to the [serialization](#) of the [WebSocket](#) object's [url](#)'s [origin](#), and the [data](#) attribute initialized to [dataForEvent](#).

User agents are encouraged to check if they can perform the above steps efficiently before they run the task, picking tasks from other [task queues](#) while they prepare the buffers if not. For example, if the [binaryType](#) attribute was set to "[blob](#)" when the data arrived, and the user agent spooled all the data to disk, but just before running the above [task](#) for this particular message the script switched [binaryType](#) to "[arraybuffer](#)", the user agent would want to page the data back to RAM before running this [task](#) so as to avoid stalling the main thread while it created the [ArrayBuffer](#) object.

Here is an example of how to define a handler for the [message](#) event in the case of text frames:

```
mysocket.onmessage = function (event) {
 if (event.data == 'on') {
 turnLampOn();
 }
}
```

```
 } else if (event.data == 'off') {
 turnLampOff();
 }
};
```

The protocol here is a trivial one, with the server just sending "on" or "off" messages.

---

When [the WebSocket closing handshake is started](#), the user agent must [queue a task](#) to change the [readyState](#) attribute's value to [CLOSING](#) (2). (If the [close\(\)](#) method was called, the [readyState](#) attribute's value will already be set to [CLOSING](#) (2) when this task runs.) [\[WSP\]](#)

---

When [the WebSocket connection is closed](#), possibly *cleanly*, the user agent must [queue a task](#) to run the following substeps:

1. Change the [readyState](#) attribute's value to [CLOSED](#) (3).
2. If the user agent was required to [fail the WebSocket connection](#), or if [the WebSocket connection was closed](#) after being flagged as full, [fire an event named error](#) at the [WebSocket](#) object. [\[WSP\]](#)
3. [Fire an event named close](#) at the [WebSocket](#) object, using [CloseEvent](#), with the [wasClean](#) attribute initialized to true if the connection closed *cleanly* and false otherwise, the [code](#) attribute initialized to [the WebSocket connection close code](#), and the [reason](#) attribute initialized to the result of applying [UTF-8 decode without BOM](#) to [the WebSocket connection close reason](#). [\[WSP\]](#)

User agents must not convey any failure information to scripts in a way that would allow a script to distinguish the following situations:

- A server whose host name could not be resolved.
- A server to which packets could not successfully be routed.
- A server that refused the connection on the specified port.
- A server that failed to correctly perform a TLS handshake (e.g., the server certificate can't be verified).
- A server that did not complete the opening handshake (e.g. because it was not a WebSocket server).
- A WebSocket server that sent a correct opening handshake, but that specified options that caused the client to drop the connection (e.g. the server specified a subprotocol that the client did not offer).
- A WebSocket server that abruptly closed the connection after successfully completing the opening handshake.

In all of these cases, [the WebSocket connection close code](#) would be 1006, as required by [WebSocket Protocol](#). [\[WSP\]](#)

Allowing a script to distinguish these cases would allow a script to probe the user's local network in preparation for an attack.

In particular, this means the code 1015 is not used by the user agent (unless the server erroneously uses it in its close frame, of course).

---

The [task source](#) for all [tasks queued](#) in this section is the *WebSocket task source*.

#### 9.3.4 Ping and Pong frames

The *WebSocket protocol* defines Ping and Pong frames that can be used for keep-alive, heartbeats, network status probing, latency instrumentation, and so forth. These are not currently exposed in the API.

User agents may send ping and unsolicited pong frames as desired, for example in an attempt to maintain local network NAT mappings, to detect failed connections, or to display latency metrics to the user. User agents must not use pings or unsolicited pongs to aid the server; it is assumed that servers will solicit pongs whenever appropriate for the server's needs.

#### 9.3.5 The [CloseEvent](#) interface



##### [CloseEvent](#)

Support in all current engines.

Firefox 8+ | Safari 6+ | Chrome 13+

Opera 12.1+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 10+

Firefox | Android 8+ | Safari iOS 6+ | Chrome | Android 18+ | WebView | Android 37+ | Samsung Internet 1.0+ | Opera | Android 12.1+

[WebSocket](#) objects use the [CloseEvent](#) interface for their [close](#) events:

```
[Exposed=(Window,Worker)]
interface CloseEvent : Event {
 constructor(DOMString type, optional CloseEventInit eventInitDict = {});

 readonly attribute boolean wasClean;
 readonly attribute unsigned short code;
 readonly attribute USVString reason;
};

dictionary CloseEventInit : EventInit {
```

```
boolean wasClean = false;
unsigned short code = 0;
USVString reason = "";
};
```

### ***event.wasClean***

Returns true if the connection closed cleanly; false otherwise.

### ***event.code***

Returns the WebSocket connection close code provided by the server.

### ***event.reason***

Returns the WebSocket connection close reason provided by the server.

The *wasClean* attribute must return the value it was initialized to. It represents whether the connection closed cleanly or not.

The *code* attribute must return the value it was initialized to. It represents the WebSocket connection close code provided by the server.

The *reason* attribute must return the value it was initialized to. It represents the WebSocket connection close reason provided by the server.

## 9.3.6 Garbage collection

A [WebSocket](#) object whose [readyState](#) attribute's value was set to [CONNECTING](#) (0) as of the last time the [event loop](#) reached [step 1](#) must not be garbage collected if there are any event listeners registered for [open](#) events, [message](#) events, [error](#) events, or [close](#) events.

A [WebSocket](#) object whose [readyState](#) attribute's value was set to [OPEN](#) (1) as of the last time the [event loop](#) reached [step 1](#) must not be garbage collected if there are any event listeners registered for [message](#) events, [error](#), or [close](#) events.

A [WebSocket](#) object whose [readyState](#) attribute's value was set to [CLOSING](#) (2) as of the last time the [event loop](#) reached [step 1](#) must not be garbage collected if there are any event listeners registered for [error](#) or [close](#) events.

A [WebSocket](#) object with [an established connection](#) that has data queued to be transmitted to the network must not be garbage collected. [\[WSP\]](#)

If a [WebSocket](#) object is garbage collected while its connection is still open, the user agent must [start the WebSocket closing handshake](#), with no status code for the Close message. [\[WSP\]](#)

---

If a user agent is to *make disappear* a [WebSocket](#) object (this happens when a [Document](#) object goes away), the user agent must follow the first appropriate set of steps from the following list:

If the WebSocket connection is not yet [\*established\* \[WSP\]](#)

[\*Fail the WebSocket connection.\* \[WSP\]](#)

If the WebSocket closing handshake has not yet been [\*started\* \[WSP\]](#)

[\*Start the WebSocket closing handshake\*](#), with the status code to use in the WebSocket Close message being 1001. [\[WSP\]](#)

Otherwise

Do nothing.

## 9.4 Cross-document messaging



### [Window/postMessage](#)

Support in all current engines.

Firefox 8+ | Safari 4+ | Chrome 1+

---

Opera 9.5+ | Edge 79+

---

Edge (Legacy) 12+ | Internet Explorer 10+

---

Firefox | Android 8+ | Safari iOS 3.2+ | Chrome | Android 18+ | WebView | Android <= 37+ | Samsung Internet 1.0+ | Opera | Android 10.1+

Web browsers, for security and privacy reasons, prevent documents in different domains from affecting each other; that is, cross-site scripting is disallowed.

While this is an important security feature, it prevents pages from different domains from communicating even when those pages are not hostile. This section introduces a messaging system that allows documents to communicate with each other regardless of their source domain, in a way designed to not enable cross-site scripting attacks.

The [postMessage\(\)](#) API can be used as a [tracking vector](#).

### 9.4.1 Introduction

*This section is non-normative.*

For example, if document A contains an [iframe](#) element that contains document B, and script

in document A calls [postMessage\(\)](#) on the [Window](#) object of document B, then a message event will be fired on that object, marked as originating from the [Window](#) of document A. The script in document A might look like:

```
var o = document.getElementsByTagName('iframe')[0];
o.contentWindow.postMessage('Hello world', 'https://b.example.org/');
```

To register an event handler for incoming events, the script would use [addEventListener\(\)](#) (or similar mechanisms). For example, the script in document B might look like:

```
window.addEventListener('message', receiver, false);
function receiver(e) {
 if (e.origin == 'https://example.com') {
 if (e.data == 'Hello world') {
 e.source.postMessage('Hello', e.origin);
 } else {
 alert(e.data);
 }
 }
}
```

This script first checks the domain is the expected domain, and then looks at the message, which it either displays to the user, or responds to by sending a message back to the document which sent the message in the first place.

## 9.4.2 Security

### 9.4.2.1 Authors

Use of this API requires extra care to protect users from hostile entities abusing a site for their own purposes.

Authors should check the [origin](#) attribute to ensure that messages are only accepted from domains that they expect to receive messages from. Otherwise, bugs in the author's message handling code could be exploited by hostile sites.

Furthermore, even after checking the [origin](#) attribute, authors should also check that the data in question is of the expected format. Otherwise, if the source of the event has been attacked using a cross-site scripting flaw, further unchecked processing of information sent using the [postMessage\(\)](#) method could result in the attack being propagated into the receiver.

Authors should not use the wildcard keyword (\*) in the *targetOrigin* argument in messages that contain any confidential information, as otherwise there is no way to guarantee that the message is only delivered to the recipient to which it was intended.

---

Authors who accept messages from any origin are encouraged to consider the risks of a denial-of-service attack. An attacker could send a high volume of messages; if the receiving page performs expensive computation or causes network traffic to be sent for each such message, the attacker's message could be multiplied into a denial-of-service attack. Authors are encouraged to employ rate limiting (only accepting a certain number of messages per minute) to make such attacks impractical.

#### 9.4.2.2 User agents

The integrity of this API is based on the inability for scripts of one [origin](#) to post arbitrary events (using `dispatchEvent()` or otherwise) to objects in other origins (those that are not the [same](#)).

Implementers are urged to take extra care in the implementation of this feature. It allows authors to transmit information from one domain to another domain, which is normally disallowed for security reasons. It also requires that UAs be careful to allow access to certain properties but not others.

---

User agents are also encouraged to consider rate-limiting message traffic between different [origins](#), to protect naïve sites from denial-of-service attacks.

#### 9.4.3 Posting messages

`window.postMessage(message [, options ])`



[Window/postMessage](#)

Support in all current engines.

Firefox 8+ | Safari 4+ | Chrome 1+

Opera 9.5+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 10+

Firefox | Android 8+ | Safari iOS 3.2+ | Chrome | Android 18+ | WebView | Android 37+ | Samsung Internet 1.0+ | Opera | Android 10.1+

Posts a message to the given window. Messages can be structured objects, e.g. nested objects and arrays, can contain JavaScript values (strings, numbers, [Date](#) objects, etc.), and can contain certain data objects such as [File](#), [Blob](#), [FileList](#), and [ArrayBuffer](#) objects.

Objects listed in the [transfer](#) member of *options* are transferred, not just cloned, meaning that they are no longer usable on the sending side.

A target origin can be specified using the [targetOrigin](#) member of *options*. If not

provided, it defaults to "/". This default restricts the message to same-origin targets only.

If the origin of the target window doesn't match the given target origin, the message is discarded, to avoid information leakage. To send the message to the target regardless of origin, set the target origin to "\*".

Throws a "[DataCloneError](#)" [DOMException](#) if *transfer* array contains duplicate objects or if *message* could not be cloned.

### `window.postMessage(message, targetOrigin [, transfer])`

This is an alternate version of [postMessage\(\)](#) where the target origin is specified as a parameter. Calling `window.postMessage(message, target, transfer)` is equivalent to `window.postMessage(message, {targetOrigin, transfer})`.

When posting a message to a [Window](#) of a [browsing context](#) that has just been navigated to a new [Document](#) is likely to result in the message not receiving its intended recipient: the scripts in the target [browsing context](#) have to have had time to set up listeners for the messages. Thus, for instance, in situations where a message is to be sent to the [Window](#) of newly created child [iframe](#), authors are advised to have the child [Document](#) post a message to their parent announcing their readiness to receive messages, and for the parent to wait for this message before beginning posting messages.

The *window post message steps*, given a *targetWindow*, *message*, and *options*, are as follows:

1. Let *targetRealm* be *targetWindow*'s [Realm](#).
2. Let *incumbentSettings* be the [incumbent settings object](#).
3. Let *targetOrigin* be *options*[["targetOrigin"](#)].
4. If *targetOrigin* is a single U+002F SOLIDUS character (/), then set *targetOrigin* to *incumbentSettings*'s [origin](#).
5. Otherwise, if *targetOrigin* is not a single U+002A ASTERISK character (\*), then:
  1. Let *parsedURL* be the result of running the [URL parser](#) on *targetOrigin*.
  2. If *parsedURL* is failure, then throw a "[SyntaxError](#)" [DOMException](#).
  3. Set *targetOrigin* to *parsedURL*'s [origin](#).
6. Let *transfer* be *options*[["transfer"](#)].
7. Let *serializeWithTransferResult* be [StructuredSerializeWithTransfer](#)(*message*, *transfer*). Rethrow any exceptions.
8. [Queue a global task](#) on the posted message task source given *targetWindow* to run the

following steps:

1. If the *targetOrigin* argument is not a single literal U+002A ASTERISK character (\*) and *targetWindow*'s [associated Document](#)'s [origin](#) is not [same origin](#) with *targetOrigin*, then return.
2. Let *origin* be the [serialization](#) of *incumbentSettings*'s [origin](#).
3. Let *source* be the [WindowProxy](#) object corresponding to *incumbentSettings*'s [global object](#) (a [Window](#) object).
4. Let *deserializeRecord* be [StructuredDeserializeWithTransfer](#)(*serializeWithTransferResult*, *targetRealm*).

If this throws an exception, catch it, [fire an event](#) named [messageerror](#) at *targetWindow*, using [MessageEvent](#), with the [origin](#) attribute initialized to *origin* and the [source](#) attribute initialized to *source*, and then return.

5. Let *messageClone* be *deserializeRecord*.[[Deserialized]].
6. Let *newPorts* be a new [frozen array](#) consisting of all [MessagePort](#) objects in *deserializeRecord*.[[TransferredValues]], if any, maintaining their relative order.
7. [Fire an event](#) named [message](#) at *targetWindow*, using [MessageEvent](#), with the [origin](#) attribute initialized to *origin*, the [source](#) attribute initialized to *source*, the [data](#) attribute initialized to *messageClone*, and the [ports](#) attribute initialized to *newPorts*.

The [Window](#) interface's *postMessage(message, options)* method steps are to run the [window post message steps](#) given *this*, *message*, and *options*.

The [Window](#) interface's *postMessage(message, targetOrigin, transfer)* method steps are to run the [window post message steps](#) given *this*, *message*, and «[ "[targetOrigin](#)" → *targetOrigin*, "[transfer](#)" → *transfer* ]».

## 9.5 Channel messaging



[Channel Messaging API](#)

Support in all current engines.

Firefox 41+ | Safari 5+ | Chrome 4+

Opera 10.6+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 10+

Firefox Android41+Safari iOS4.2+Chrome Android18+WebView Android4.4+Samsung Internet1.0+Opera Android11+

## [Channel\\_Messaging\\_API/Using\\_channel\\_messageing](#)

Support in all current engines.

Firefox41+Safari5+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android41+Safari iOS4.2+Chrome Android18+WebView Android4.4+Samsung Internet1.0+Opera Android11+

### 9.5.1 Introduction

*This section is non-normative.*

To enable independent pieces of code (e.g. running in different [browsing contexts](#)) to communicate directly, authors can use [channel messaging](#).

Communication channels in this mechanism are implemented as two-ways pipes, with a port at each end. Messages sent in one port are delivered at the other port, and vice-versa. Messages are delivered as DOM events, without interrupting or blocking running [tasks](#).

To create a connection (two "entangled" ports), the **MessageChannel()** constructor is called:

```
var channel = new MessageChannel();
```

One of the ports is kept as the local port, and the other port is sent to the remote code, e.g. using [postMessage\(\)](#):

```
otherWindow.postMessage('hello', 'https://example.com', [channel.port2]);
```

To send messages, the [postMessage\(\)](#) method on the port is used:

```
channel.port1.postMessage('hello');
```

To receive messages, one listens to [message](#) events:

```
channel.port1.onmessage = handleMessage;
function handleMessage(event) {
 // message is in event.data
 // ...
}
```

Data sent on a port can be structured data; for example here an array of strings is passed on a [MessagePort](#):

```
port1.postMessage(['hello', 'world']);
```

#### 9.5.1.1 Examples

*This section is non-normative.*

In this example, two JavaScript libraries are connected to each other using [MessagePort](#)s. This allows the libraries to later be hosted in different frames, or in [Worker](#) objects, without any change to the APIs.

```
<script src="contacts.js"></script> <!-- exposes a contacts object -->
<script src="compose-mail.js"></script> <!-- exposes a composer object -->
<script>
 var channel = new MessageChannel();
 composer.addContactsProvider(channel.port1);
 contacts.registerConsumer(channel.port2);
</script>
```

Here's what the "addContactsProvider()" function's implementation could look like:

```
function addContactsProvider(port) {
 port.onmessage = function (event) {
 switch (event.data.messageType) {
 case 'search-result': handleSearchResult(event.data.results); break;
 case 'search-done': handleSearchDone(); break;
 case 'search-error': handleSearchError(event.data.message); break;
 // ...
 }
 };
};
```

Alternatively, it could be implemented as follows:

```
function addContactsProvider(port) {
 port.addEventListener('message', function (event) {
 if (event.data.messageType == 'search-result')
 handleSearchResult(event.data.results);
 });
 port.addEventListener('message', function (event) {
 if (event.data.messageType == 'search-done')
 handleSearchDone();
 });
 port.addEventListener('message', function (event) {
 if (event.data.messageType == 'search-error')
 handleSearchError(event.data.message);
 });
// ...
```

```
 port.start();
};
```

The key difference is that when using `addEventListener()`, the `start()` method must also be invoked. When using `onmessage`, the call to `start()` is implied.

The `start()` method, whether called explicitly or implicitly (by setting `onmessage`), starts the flow of messages: messages posted on message ports are initially paused, so that they don't get dropped on the floor before the script has had a chance to set up its handlers.

#### 9.5.1.2 Ports as the basis of an object-capability model on the web

*This section is non-normative.*

Ports can be viewed as a way to expose limited capabilities (in the object-capability model sense) to other actors in the system. This can either be a weak capability system, where the ports are merely used as a convenient model within a particular origin, or as a strong capability model, where they are provided by one origin *provider* as the only mechanism by which another origin *consumer* can effect change in or obtain information from *provider*.

For example, consider a situation in which a social web site embeds in one `iframe` the user's email contacts provider (an address book site, from a second origin), and in a second `iframe` a game (from a third origin). The outer social site and the game in the second `iframe` cannot access anything inside the first `iframe`; together they can only:

- Navigate the `iframe` to a new `URL`, such as the same `URL` but with a different `fragment`, causing the `Window` in the `iframe` to receive a `hashchange` event.
- Resize the `iframe`, causing the `Window` in the `iframe` to receive a `resize` event.
- Send a `message` event to the `Window` in the `iframe` using the `window.postMessage()` API.

The contacts provider can use these methods, most particularly the third one, to provide an API that can be accessed by other origins to manipulate the user's address book. For example, it could respond to a message "**add-contact Guillaume Tell <tell@pomme.example.net>**" by adding the given person and email address to the user's address book.

To avoid any site on the web being able to manipulate the user's contacts, the contacts provider might only allow certain trusted sites, such as the social site, to do this.

Now suppose the game wanted to add a contact to the user's address book, and that the social site was willing to allow it to do so on its behalf, essentially "sharing" the trust that the contacts provider had with the social site. There are several ways it could do this; most simply, it could just proxy messages between the game site and the contacts site. However, this solution has a number of difficulties: it requires the social site to either completely trust the game site not to abuse the privilege, or it requires that the social site verify each request to make sure it's not a request that it doesn't want to allow (such as adding multiple contacts, reading the contacts, or

deleting them); it also requires some additional complexity if there's ever the possibility of multiple games simultaneously trying to interact with the contacts provider.

Using message channels and [MessagePort](#) objects, however, all of these problems can go away. When the game tells the social site that it wants to add a contact, the social site can ask the contacts provider not for it to add a contact, but for the *capability* to add a single contact. The contacts provider then creates a pair of [MessagePort](#) objects, and sends one of them back to the social site, who forwards it on to the game. The game and the contacts provider then have a direct connection, and the contacts provider knows to only honor a single "add contact" request, nothing else. In other words, the game has been granted the capability to add a single contact.

#### 9.5.1.3 Ports as the basis of abstracting out service implementations

*This section is non-normative.*

Continuing the example from the previous section, consider the contacts provider in particular. While an initial implementation might have simply used [XMLHttpRequest](#) objects in the service's [iframe](#), an evolution of the service might instead want to use a [shared worker](#) with a single [WebSocket](#) connection.

If the initial design used [MessagePort](#) objects to grant capabilities, or even just to allow multiple simultaneous independent sessions, the service implementation can switch from the [XMLHttpRequest](#)s-in-each-[iframe](#) model to the shared-[WebSocket](#) model without changing the API at all: the ports on the service provider side can all be forwarded to the shared worker without it affecting the users of the API in the slightest.

#### 9.5.2 Message channels



##### [MessageChannel](#)

Support in all current engines.

Firefox 41+ Safari 5+ Chrome 4+

---

Opera 10.6+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 41+ Safari iOS 4.2+ Chrome Android 18+ WebView Android 4.4+ Samsung Internet 1.0+ Opera Android 11+

```
[Exposed=(Window,Worker)]
interface MessageChannel {
 constructor();
 readonly attribute MessagePort port1;
```

```
 readonly attribute MessagePort port2;
};
```

***channel*** = new [MessageChannel\(\)](#)

✓MDN

[MessageChannel/MessageChannel](#)

Support in all current engines.

Firefox41+Safari5+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android41+Safari iOS4.2+Chrome Android18+WebView Android4.4+Samsung Internet1.0+Opera Android11+

Returns a new [MessageChannel](#) object with two new [MessagePort](#) objects.

***channel.port1***

✓MDN

[MessageChannel/port1](#)

Support in all current engines.

Firefox41+Safari5+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android41+Safari iOS4.2+Chrome Android18+WebView Android4.4+Samsung Internet1.0+Opera Android11+

Returns the first [MessagePort](#) object.

## `channel.port2`



### [MessageChannel/port2](#)

Support in all current engines.

Firefox 41+ | Safari 5+ | Chrome 4+

Opera 10.6+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 10+

Firefox Android 41+ | Safari iOS 4.2+ | Chrome Android 18+ | WebView Android 4.4+ | Samsung Internet 1.0+ | Opera Android 11+

Returns the second [MessagePort](#) object.

A [MessageChannel](#) object has an associated *port 1* and an associated *port 2*, both [MessagePort](#) objects.

The `new MessageChannel()` constructor steps are:

1. Set `this`'s *port 1* to a `new MessagePort` in `this`'s [relevant Realm](#).
2. Set `this`'s *port 2* to a `new MessagePort` in `this`'s [relevant Realm](#).
3. [Entangle](#) `this`'s *port 1* and `this`'s *port 2*.

The *port1* getter steps are to return `this`'s *port 1*.

The *port2* getter steps are to return `this`'s *port 2*.

### 9.5.3 Message ports



### [MessagePort](#)

Support in all current engines.

Firefox 41+ | Safari 5+ | Chrome 4+

Opera 10.6+ | Edge 79+

Edge (Legacy) 12+ | Internet Explorer 10+

Firefox Android 41+ | Safari iOS 4.2+ | Chrome Android 18+ | WebView Android 37+ | Samsung Internet 1.0+ | Opera Android 11+

Each channel has two message ports. Data sent through one port is received by the other port, and vice versa.

```
[Exposed=(Window,Worker,AudioWorklet), Transferable]
interface MessagePort : EventTarget {
 undefined postMessage(any message, sequence<object> transfer);
 undefined postMessage(any message, optional StructuredSerializeOptions options);
 undefined start();
 undefined close();

 // event handlers
 attribute EventHandler onmessage;
 attribute EventHandler onmessageerror;
};

dictionary StructuredSerializeOptions {
 sequence<object> transfer = [];
};

port.postMessage(message [, transfer])
```

✓MDN

## [MessagePort/postMessage](#)

Support in all current engines.

---

Firefox41+Safari5+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android41+Safari iOS4.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android11+

**port.postMessage(message [, { transfer }])**

Posts a message through the channel. Objects listed in *transfer* are transferred, not just cloned, meaning that they are no longer usable on the sending side.

Throws a ["DataCloneError" DOMException](#) if *transfer* contains duplicate objects or *port*, or if *message* could not be cloned.

**port.start()**

✓MDN

## [MessagePort/start](#)

Support in all current engines.

---

Firefox41+Safari5+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android41+Safari iOS4.2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

Begins dispatching messages received on the port.

## [`port.close\(\)`](#)

✓MDN

### [MessagePort/close](#)

Support in all current engines.

Firefox41+Safari5+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android41+Safari iOS4.2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

Disconnects the port, so that it is no longer active.

Each [MessagePort](#) object can be entangled with another (a symmetric relationship). Each [MessagePort](#) object also has a [task source](#) called the *port message queue*, initially empty. A [port message queue](#) can be enabled or disabled, and is initially disabled. Once enabled, a port can never be disabled again (though messages in the queue can get moved to another queue or removed altogether, which has much the same effect). A [MessagePort](#) also has a *has been shipped* flag, which must initially be false.

When a port's [port message queue](#) is enabled, the [event loop](#) must use it as one of its [task sources](#). When a port's [relevant global object](#) is a [Window](#), all [tasks queued](#) on its [port message queue](#) must be associated with the port's [relevant global object's associated Document](#).

If the document is [fully active](#), but the event listeners all have scripts whose [settings objects](#) specify [responsible documents](#) that are *not* [fully active](#), then the messages will not be received unless and until the documents become [fully active](#) again.

Each [event loop](#) has a [task source](#) called the *unshipped port message queue*. This is a virtual [task source](#): it must act as if it contained the [tasks](#) of each [port message queue](#) of each [MessagePort](#) whose [has been shipped](#) flag is false, whose [port message queue](#) is enabled, and whose [relevant agent's event loop](#) is that [event loop](#), in the order in which they were added to their respective [task source](#). When a [task](#) would be removed from the [unshipped port message queue](#), it must instead be removed from its [port message queue](#).

When a [MessagePort](#)'s [has been shipped](#) flag is false, its [port message queue](#) must be ignored for the purposes of the [event loop](#). (The [unshipped port message queue](#) is used instead.)

The [has been shipped](#) flag is set to true when a port, its twin, or the object it was cloned from, is or has been transferred. When a [MessagePort](#)'s [has been shipped](#) flag is true, its [port message](#)

[queue](#) acts as a first-class [task source](#), unaffected to any [unshipped port message queue](#).

When the user agent is to *entangle* two [MessagePort](#) objects, it must run the following steps:

1. If one of the ports is already entangled, then disentangle it and the port that it was entangled with.

If those two previously entangled ports were the two ports of a [MessageChannel](#) object, then that [MessageChannel](#) object no longer represents an actual channel: the two ports in that object are no longer entangled.

2. Associate the two ports to be entangled, so that they form the two parts of a new channel. (There is no [MessageChannel](#) object that represents this channel.)

Two ports *A* and *B* that have gone through this step are now said to be entangled; one is entangled to the other, and vice versa.

While this specification describes this process as instantaneous, implementations are more likely to implement it via message passing. As with all algorithms, the key is "merely" that the end result be indistinguishable, in a black-box sense, from the specification.

---

[MessagePort](#) objects are [transferable objects](#). Their [transfer steps](#), given *value* and *dataHolder*, are:

1. Set *value*'s [has been shipped](#) flag to true.
2. Set *dataHolder*.[\[\[PortMessageQueue\]\]](#) to *value*'s [port message queue](#).
3. If *value* is entangled with another port *remotePort*, then:
  1. Set *remotePort*'s [has been shipped](#) flag to true.
  2. Set *dataHolder*.[\[\[RemotePort\]\]](#) to *remotePort*.
4. Otherwise, set *dataHolder*.[\[\[RemotePort\]\]](#) to null.

Their [transfer-receiving steps](#), given *dataHolder* and *value*, are:

1. Set *value*'s [has been shipped](#) flag to true.
2. Move all the [tasks](#) that are to fire [message](#) events in *dataHolder*.[\[\[PortMessageQueue\]\]](#) to the [port message queue](#) of *value*, if any, leaving *value*'s [port message queue](#) in its initial disabled state, and, if *value*'s [relevant global object](#) is a [Window](#), associating the moved [tasks](#) with *value*'s [relevant global object](#)'s associated [Document](#).
3. If *dataHolder*.[\[\[RemotePort\]\]](#) is not null, then [entangle](#) *dataHolder*.[\[\[RemotePort\]\]](#) and

*value*. (This will disentangle *dataHolder*.[[RemotePort]] from the original port that was transferred.)

---

The message port post message steps, given *sourcePart*, *targetPort*, *message* and *options* are as follows:

1. Let *transfer* be *options*[["transfer"](#)].
2. If *transfer* [contains](#) *sourcePort*, then throw a ["DataCloneError" DOMException](#).
3. Let *doomed* be false.
4. If *targetPort* is not null and *transfer* [contains](#) *targetPort*, then set *doomed* to true and optionally report to a developer console that the target port was posted to itself, causing the communication channel to be lost.
5. Let *serializeWithTransferResult* be [StructuredSerializeWithTransfer](#)(*message*, *transfer*). Rethrow any exceptions.
6. If *targetPort* is null, or if *doomed* is true, then return.
7. Add a [task](#) that runs the following steps to the [port message queue](#) of *targetPort*:
  1. Let *finalTargetPort* be the [MessagePort](#) in whose [port message queue](#) the task now finds itself.

This can be different from *targetPort*, if *targetPort* itself was transferred and thus all its tasks moved along with it.

2. Let *targetRealm* be *finalTargetPort*'s [relevant Realm](#).
3. Let *deserializeRecord* be [StructuredDeserializeWithTransfer](#)(*serializeWithTransferResult*, *targetRealm*).

If this throws an exception, catch it, [fire an event](#) named [messageerror](#) at *finalTargetPort*, using [MessageEvent](#), and then return.

4. Let *messageClone* be *deserializeRecord*.[[Deserialized]].
5. Let *newPorts* be a new [frozen array](#) consisting of all [MessagePort](#) objects in *deserializeRecord*.[[TransferredValues]], if any, maintaining their relative order.
6. [Fire an event](#) named [message](#) at *finalTargetPort*, using [MessageEvent](#), with the [data](#) attribute initialized to *messageClone* and the [ports](#) attribute initialized to *newPorts*.

The *postMessage(message, options)* method steps are:

1. Let *targetPort* be the port with which [this](#) is entangled, if any; otherwise let it be null.
2. Run the [message port post message steps](#) providing [this](#), *targetPort*, *message* and *options*.

The [\*postMessage\(message, transfer\)\*](#) method steps are:

1. Let *targetPort* be the port with which [this](#) is entangled, if any; otherwise let it be null.
2. Let *options* be  $\ll [ \text{"transfer"} \rightarrow \text{transfer} ] \gg$ .
3. Run the [message port post message steps](#) providing [this](#), *targetPort*, *message* and *options*.

---

The [\*start\(\)\*](#) method steps are to enable [this's port message queue](#), if it is not already enabled.

---

The [\*close\(\)\*](#) method steps are:

1. Set [this's \[\[Detached\]\]](#) internal slot value to true.
2. If [this](#) is entangled, disentangle it.

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the [MessagePort](#) interface:

	<a href="#">Event handler</a>	<a href="#">Event handler event type</a>		
<a href="#"><i>onmessage</i></a>				
	 MDN			
	<a href="#">MessagePort/onmessage</a>	<a href="#">message</a>		
	Support in all current engines.			
Firefox	41+	Safari 5+	Chrome 4+	
Opera	10.6+	Edge 79+		
Edge (Legacy)	12+	Internet Explorer	10+	
Firefox	Android 41+	Safari iOS 4.2+	Chrome Android 18+	WebView
Android	37+	Samsung Internet	1.0+	Opera Android 11+
<a href="#"><i>onmessageerror</i></a>		<a href="#">messageerror</a>		
	 MDN			

## [Event handler](#)

## [Event handler event type](#)

### [MessagePort/onmessageerror](#)

Firefox57+SafariNoChrome60+

Opera47+Edge79+

Edge (Legacy)18Internet ExplorerNo

Firefox Android57+Safari iOSNoChrome Android60+WebView

Android60+Samsung Internet8.0+Opera Android44+

The first time a [MessagePort](#) object's [onmessage](#) IDL attribute is set, the port's [port message queue](#) must be enabled, as if the [start\(\)](#) method had been called.

#### 9.5.4 Broadcasting to many ports

*This section is non-normative.*

Broadcasting to many ports is in principle relatively simple: keep an array of [MessagePort](#) objects to send messages to, and iterate through the array to send a message. However, this has one rather unfortunate effect: it prevents the ports from being garbage collected, even if the other side has gone away. To avoid this problem, implement a simple protocol whereby the other side acknowledges it still exists. If it doesn't do so after a certain amount of time, assume it's gone, close the [MessagePort](#) object, and let it be garbage collected.

#### 9.5.5 Ports and garbage collection

When a [MessagePort](#) object *o* is entangled, user agents must either act as if *o*'s entangled [MessagePort](#) object has a strong reference to *o*, or as if *o*'s [relevant global object](#) has a strong reference to *o*.

Thus, a message port can be received, given an event listener, and then forgotten, and so long as that event listener could receive a message, the channel will be maintained.

Of course, if this was to occur on both sides of the channel, then both ports could be garbage collected, since they would not be reachable from live code, despite having a strong reference to each other.

Furthermore, a [MessagePort](#) object must not be garbage collected while there exists an event referenced by a [task](#) in a [task queue](#) that is to be dispatched on that [MessagePort](#) object, or while the [MessagePort](#) object's [port message queue](#) is enabled and not empty.

Authors are strongly encouraged to explicitly close [MessagePort](#) objects to disentangle them, so that their resources can be recollected. Creating many [MessagePort](#) objects and discarding them without closing them can lead to high transient memory usage since garbage collection is not necessarily performed promptly, especially for [MessagePort](#)s where garbage collection

can involve cross-process coordination.

## 9.6 Broadcasting to other browsing contexts



### [BroadcastChannel](#)

Support in all current engines.

Firefox 38+ Safari iOS preview+ Chrome 54+

Opera 41+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 38+ Safari iOS No Chrome Android 54+ WebView Android 54+ Samsung Internet 6.0+ Opera Android 41+

### [Broadcast\\_Channel\\_API](#)

Support in all current engines.

Firefox 38+ Safari iOS preview+ Chrome 54+

Opera 41+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 38+ Safari iOS No Chrome Android 54+ WebView Android 54+ Samsung Internet 6.0+ Opera Android 41+

Pages on a single [origin](#) opened by the same user in the same user agent but in different unrelated [browsing contexts](#) sometimes need to send notifications to each other, for example "hey, the user logged in over here, check your credentials again".

For elaborate cases, e.g. to manage locking of shared state, to manage synchronization of resources between a server and multiple local clients, to share a [WebSocket](#) connection with a remote host, and so forth, [shared workers](#) are the most appropriate solution.

For simple cases, though, where a shared worker would be an unreasonable overhead, authors can use the simple channel-based broadcast mechanism described in this section.

```
[Exposed=(Window,Worker)]
interface BroadcastChannel : EventTarget {
 constructor(DOMString name);

 readonly attribute DOMString name;
 undefined postMessage(any message);
 undefined close();
 attribute EventHandler onmessage;
 attribute EventHandler onmessageerror;
```

};

**broadcastChannel** = new [BroadcastChannel\(name\)](#)

✓MDN

[BroadcastChannel/BroadcastChannel](#)

Support in all current engines.

Firefox38+Safari<sup>1</sup> preview+Chrome54+

Opera41+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android38+Safari iOSNoChrome Android54+WebView Android54+Samsung Internet6.0+Opera Android41+

Returns a new [BroadcastChannel](#) object via which messages for the given channel name can be sent and received.

**broadcastChannel.name**

✓MDN

[BroadcastChannel/name](#)

Support in all current engines.

Firefox38+Safari<sup>1</sup> preview+Chrome54+

Opera41+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android38+Safari iOSNoChrome Android54+WebView Android54+Samsung Internet6.0+Opera Android41+

Returns the channel name (as passed to the constructor).

## `broadcastChannel.postMessage(message)`

✓MDN

### [BroadcastChannel/postMessage](#)

Support in all current engines.

Firefox 38+ Safari iOS preview+ Chrome 54+

Opera 41+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 38+ Safari iOS No Chrome Android 54+ WebView Android 54+ Samsung Internet 6.0+ Opera Android 41+

Sends the given message to other [BroadcastChannel](#) objects set up for this channel.  
Messages can be structured objects, e.g. nested objects and arrays.

## `broadcastChannel.close()`

✓MDN

### [BroadcastChannel/close](#)

Support in all current engines.

Firefox 38+ Safari iOS preview+ Chrome 54+

Opera 41+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 38+ Safari iOS No Chrome Android 54+ WebView Android 54+ Samsung Internet 6.0+ Opera Android 41+

Closes the [BroadcastChannel](#) object, opening it up to garbage collection.

A [BroadcastChannel](#) object has a *channel name* and a *closed flag*.

The *new BroadcastChannel(name)* constructor steps are:

1. Set `this`'s [channel name](#) to `name`.
2. Set `this`'s [closed flag](#) to false.

The `name` getter steps are to return `this`'s [channel name](#).

A [BroadcastChannel](#) object is said to be *eligible for messaging* when its [relevant global object](#) is either:

- a [Window](#) object whose [associated Document](#) is [fully active](#), or

- a [WorkerGlobalScope](#) object whose [closing](#) flag is false and whose [worker](#) is not a [suspendable worker](#).

The `postMessage(message)` method steps are:

1. If [this](#) is not [eligible for messaging](#), then return.
2. If [this](#)'s [closed flag](#) is true, then throw an ["InvalidStateError" DOMException](#).
3. Let `serialized` be [StructuredSerialize\(message\)](#). Rethrow any exceptions.
4. Let `sourceOrigin` be [this](#)'s [relevant settings object](#)'s [origin](#).
5. Let `destinations` be a list of [BroadcastChannel](#) objects that match the following criteria:
  - They are [eligible for messaging](#).
  - Their [relevant settings object](#)'s [origin](#) is [same origin](#) with `sourceOrigin`.
  - Their [channel name](#) is [this](#)'s [channel name](#).
6. Remove `source` from `destinations`.
7. Sort `destinations` such that all [BroadcastChannel](#) objects whose [relevant agents](#) are the same are sorted in creation order, oldest first. (This does not define a complete ordering. Within this constraint, user agents may sort the list in any [implementation-defined](#) manner.)
8. For each `destination` in `destinations`, [queue a global task](#) on the [DOM manipulation task source](#) given `destination`'s [relevant global object](#) to perform the following steps:
  1. If `destination`'s [closed flag](#) is true, then abort these steps.
  2. Let `targetRealm` be `destination`'s [relevant Realm](#).
  3. Let `data` be [StructuredDeserialize\(serialized, targetRealm\)](#).

If this throws an exception, catch it, [fire an event](#) named [messageerror](#) at `destination`, using [MessageEvent](#), with the [origin](#) attribute initialized to the [serialization](#) of `sourceOrigin`, and then abort these steps.

  4. [Fire an event](#) named [message](#) at `destination`, using [MessageEvent](#), with the [data](#) attribute initialized to `data` and the [origin](#) attribute initialized to the [serialization](#) of `sourceOrigin`.

While a [BroadcastChannel](#) object whose [closed flag](#) is false has an event listener registered for [message](#) or [messageerror](#) events, there must be a strong reference from the

[BroadcastChannel](#) object's [relevant global object](#) to the [BroadcastChannel](#) object itself.

The `close()` method steps are to set [this](#)'s [closed](#) flag to true.

Authors are strongly encouraged to explicitly close [BroadcastChannel](#) objects when they are no longer needed, so that they can be garbage collected. Creating many [BroadcastChannel](#) objects and discarding them while leaving them with an event listener and without closing them can lead to an apparent memory leak, since the objects will continue to live for as long as they have an event listener (or until their page or worker is closed).

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by all objects implementing the [BroadcastChannel](#) interface:

	<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
<i>onmessage</i>		
	 MDN	
	<a href="#">BroadcastChannel/onmessage</a>	
	Support in all current engines.	<a href="#">message</a>
	Firefox 38+ Safari iOS preview+ Chrome 54+	
	Opera 41+ Edge 79+	
	Edge (Legacy) No Internet Explorer No	
	Firefox Android 38+ Safari iOS No Chrome Android 54+ WebView	
	Android 54+ Samsung Internet 6.0+ Opera Android 41+	
<i>onmessageerror</i>		
	 MDN	
	<a href="#">BroadcastChannel/onmessageerror</a>	
	Support in all current engines.	<a href="#">messageerror</a>
	Firefox 57+ Safari iOS preview+ Chrome 60+	
	Opera 47+ Edge 79+	
	Edge (Legacy) No Internet Explorer No	
	Firefox Android 57+ Safari iOS No Chrome Android 60+ WebView	
	Android 60+ Samsung Internet 8.0+ Opera Android 44+	

Suppose a page wants to know when the user logs out, even when the user does so from another tab at the same site:

```

var authChannel = new BroadcastChannel('auth');
authChannel.onmessage = function (event) {
 if (event.data == 'logout')
 showLogout();
}

function logoutRequested() {
 // called when the user asks us to log them out
 doLogout();
 showLogout();
 authChannel.postMessage('logout');
}

function doLogout() {
 // actually log the user out (e.g. clearing cookies)
 // ...
}

function showLogout() {
 // update the UI to indicate we're logged out
 // ...
}

```

## 10 Web workers



### [Web\\_Workers\\_API](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 4+ Samsung Internet 1.0+ Opera Android 11+

### [Web\\_Workers\\_API/Using\\_web\\_workers](#)

#### 10.1 Introduction

##### 10.1.1 Scope

*This section is non-normative.*

This specification defines an API for running scripts in the background independently of any

user interface scripts.

This allows for long-running scripts that are not interrupted by scripts that respond to clicks or other user interactions, and allows long tasks to be executed without yielding to keep the page responsive.

Workers (as these background scripts are called herein) are relatively heavy-weight, and are not intended to be used in large numbers. For example, it would be inappropriate to launch one worker for each pixel of a four megapixel image. The examples below show some appropriate uses of workers.

Generally, workers are expected to be long-lived, have a high start-up performance cost, and a high per-instance memory cost.

### 10.1.2 Examples

*This section is non-normative.*

There are a variety of uses that workers can be put to. The following subsections show various examples of this use.

#### 10.1.2.1 A background number-crunching worker

*This section is non-normative.*

The simplest use of workers is for performing a computationally expensive task without interrupting the user interface.

In this example, the main document spawns a worker to (naively) compute prime numbers, and progressively displays the most recently found prime number.

The main page is as follows:

```
<!DOCTYPE HTML>
<html lang="en">
 <head>
 <meta charset="utf-8">
 <title>Worker example: One-core computation</title>
 </head>
 <body>
 <p>The highest prime number discovered so far is: <output id="result"></output>
 <script>
 var worker = new Worker('worker.js');
 worker.onmessage = function (event) {
 document.getElementById('result').textContent = event.data;
 };
 </script>
```

```
</body>
</html>
```

The [Worker\(\)](#) constructor call creates a worker and returns a [Worker](#) object representing that worker, which is used to communicate with the worker. That object's [onmessage](#) event handler allows the code to receive messages from the worker.

The worker itself is as follows:

```
var n = 1;
search: while (true) {
 n += 1;
 for (var i = 2; i <= Math.sqrt(n); i += 1)
 if (n % i == 0)
 continue search;
 // found a prime!
 postMessage(n);
}
```

The bulk of this code is simply an unoptimized search for a prime number. The [postMessage\(\)](#) method is used to send a message back to the page when a prime is found.

[View this example online.](#)

#### 10.1.2.2 Using a JavaScript module as a worker

*This section is non-normative.*

All of our examples so far show workers that run [classic scripts](#). Workers can instead be instantiated using [module scripts](#), which have the usual benefits: the ability to use the JavaScript **import** statement to import other modules; strict mode by default; and top-level declarations not polluting the worker's global scope.

As the **import** statement is available, the [importScripts\(\)](#) method will automatically fail inside module workers.

In this example, the main document uses a worker to do off-main-thread image manipulation. It imports the filters used from another module.

The main page is as follows:

```
<!DOCTYPE html>
<html lang="en">
<meta charset="utf-8">
<title>Worker example: image decoding</title>

<p>
```

```
<label>
 Type an image URL to decode
 <input type="url" id="image-url" list="image-list">
 <datalist id="image-list">
 <option value="https://html.spec.whatwg.org/images/drawImage.png">
 <option value="https://html.spec.whatwg.org/images/robots.jpeg">
 <option value="https://html.spec.whatwg.org/images/arcTo2.png">
 </datalist>
</label>
</p>

<p>
<label>
 Choose a filter to apply
 <select id="filter">
 <option value="none">none</option>
 <option value="grayscale">grayscale</option>
 <option value="brighten">brighten by 20%</option>
 </select>
</label>
</p>

<div id="output"></div>

<script type="module">
 const worker = new Worker("worker.js", { type: "module" });
 worker.onmessage = receiveFromWorker;

 const url = document.querySelector("#image-url");
 const filter = document.querySelector("#filter");
 const output = document.querySelector("#output");

 url.oninput = updateImage;
 filter.oninput = sendToWorker;

 let imageData, context;

 function updateImage() {
 const img = new Image();
 img.src = url.value;

 img.onload = () => {
 const canvas = document.createElement("canvas");
 canvas.width = img.width;
 canvas.height = img.height;

 context = canvas.getContext("2d");
 }
 }
</script>
```

```

 context.drawImage(img, 0, 0);
 imageData = context.getImageData(0, 0, canvas.width, canvas.height);

 sendToWorker();
 output.replaceChildren(canvas);
 };
}

function sendToWorker() {
 worker.postMessage({ imageData, filter: filter.value });
}

function receiveFromWorker(e) {
 context.putImageData(e.data, 0, 0);
}
</script>

```

The worker file is then:

```

import * as filters from "./filters.js";

self.onmessage = e => {
 const { imageData, filter } = e.data;
 filters[filter](imageData);
 self.postMessage(imageData, [imageData.data.buffer]);
};

```

Which imports the file **filters.js**:

```

export function none() {}

export function grayscale({ data: d }) {
 for (let i = 0; i < d.length; i += 4) {
 const [r, g, b] = [d[i], d[i + 1], d[i + 2]];

 // CIE luminance for the RGB
 // The human eye is bad at seeing red and blue, so we de-emphasize them.
 d[i] = d[i + 1] = d[i + 2] = 0.2126 * r + 0.7152 * g + 0.0722 * b;
 }
};

export function brighten({ data: d }) {
 for (let i = 0; i < d.length; ++i) {
 d[i] *= 1.2;
 }
};

```

[View this example online.](#)

#### 10.1.2.3 Shared workers introduction

MDN

[SharedWorker](#)

Firefox 29+ Safari 5–7 Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 33+ Safari iOS 5–7 Chrome Android No WebView Android No Samsung Internet 4.0–5.0 Opera Android 11–14

*This section is non-normative.*

This section introduces shared workers using a Hello World example. Shared workers use slightly different APIs, since each worker can have multiple connections.

This first example shows how you connect to a worker and how a worker can send a message back to the page when it connects to it. Received messages are displayed in a log.

Here is the HTML page:

```
<!DOCTYPE HTML>
<html lang="en">
<meta charset="utf-8">
<title>Shared workers: demo 1</title>
<pre id="log">Log:</pre>
<script>
 var worker = new SharedWorker('test.js');
 var log = document.getElementById('log');
 worker.port.onmessage = function(e) { // note: not worker.onmessage!
 log.textContent += '\n' + e.data;
 }
</script>
```

Here is the JavaScript worker:

```
onconnect = function(e) {
 var port = e.ports[0];
 port.postMessage('Hello World!');
}
```

[View this example online.](#)

This second example extends the first one by changing two things: first, messages are received using `addEventListener()` instead of an [event handler IDL attribute](#), and second, a message is sent *to* the worker, causing the worker to send another message in return. Received messages are again displayed in a log.

Here is the HTML page:

```
<!DOCTYPE HTML>
<html lang="en">
<meta charset="utf-8">
<title>Shared workers: demo 2</title>
<pre id="log">Log:</pre>
<script>
 var worker = new SharedWorker('test.js');
 var log = document.getElementById('log');
 worker.port.addEventListener('message', function(e) {
 log.textContent += '\n' + e.data;
 }, false);
 worker.port.start(); // note: need this when using addEventListener
 worker.port.postMessage('ping');
</script>
```

Here is the JavaScript worker:

```
onconnect = function(e) {
 var port = e.ports[0];
 port.postMessage('Hello World!');
 port.onmessage = function(e) {
 port.postMessage('pong'); // not e.ports[0].postMessage!
 // e.target.postMessage('pong'); would work also
 }
}
```

[View this example online.](#)

---

Finally, the example is extended to show how two pages can connect to the same worker; in this case, the second page is merely in an [iframe](#) on the first page, but the same principle would apply to an entirely separate page in a separate [top-level browsing context](#).

Here is the outer HTML page:

```
<!DOCTYPE HTML>
<html lang="en">
<meta charset="utf-8">
<title>Shared workers: demo 3</title>
<pre id="log">Log:</pre>
```

```

<script>
 var worker = new SharedWorker('test.js');
 var log = document.getElementById('log');
 worker.port.addEventListener('message', function(e) {
 log.textContent += '\n' + e.data;
 }, false);
 worker.port.start();
 worker.port.postMessage('ping');
</script>
<iframe src="inner.html"></iframe>

```

Here is the inner HTML page:

```

<!DOCTYPE HTML>
<html lang="en">
<meta charset="utf-8">
<title>Shared workers: demo 3 inner frame</title>
<pre id=log>Inner log:</pre>
<script>
 var worker = new SharedWorker('test.js');
 var log = document.getElementById('log');
 worker.port.onmessage = function(e) {
 log.textContent += '\n' + e.data;
 }
</script>

```

Here is the JavaScript worker:

```

var count = 0;
onconnect = function(e) {
 count += 1;
 var port = e.ports[0];
 port.postMessage('Hello World! You are connection #' + count);
 port.onmessage = function(e) {
 port.postMessage('pong');
 }
}

```

[View this example online.](#)

#### 10.1.2.4 Shared state using a shared worker

*This section is non-normative.*

In this example, multiple windows (viewers) can be opened that are all viewing the same map. All the windows share the same map information, with a single worker coordinating all the viewers. Each viewer can move around independently, but if they set any data on the map, all

the viewers are updated.

The main page isn't interesting, it merely provides a way to open the viewers:

```
<!DOCTYPE HTML>
<html lang="en">
 <head>
 <meta charset="utf-8">
 <title>Workers example: Multiviewer</title>
 <script>
 function openViewer() {
 window.open('viewer.html');
 }
 </script>
 </head>
 <body>
 <p><button type=button onclick="openViewer()">Open a new viewer</button></p>
 <p>Each viewer opens in a new window. You can have as many viewers as you like, they all view the same data.</p>
 </body>
</html>
```

The viewer is more involved:

```
<!DOCTYPE HTML>
<html lang="en">
 <head>
 <meta charset="utf-8">
 <title>Workers example: Multiviewer viewer</title>
 <script>
 var worker = new SharedWorker('worker.js', 'core');

 // CONFIGURATION
 function configure(event) {
 if (event.data.substr(0, 4) != 'cfg ') return;
 var name = event.data.substr(4).split(' ', 1)[0];
 // update display to mention our name is name
 document.getElementsByTagName('h1')[0].textContent += ' ' + name;
 // no longer need this listener
 worker.port.removeEventListener('message', configure, false);
 }
 worker.port.addEventListener('message', configure, false);

 // MAP
 function paintMap(event) {
 if (event.data.substr(0, 4) != 'map ') return;
```

```

var data = event.data.substr(4).split(',');
// display tiles data[0] .. data[8]
var canvas = document.getElementById('map');
var context = canvas.getContext('2d');
for (var y = 0; y < 3; y += 1) {
 for (var x = 0; x < 3; x += 1) {
 var tile = data[y * 3 + x];
 if (tile == '0')
 context.fillStyle = 'green';
 else
 context.fillStyle = 'maroon';
 context.fillRect(x * 50, y * 50, 50, 50);
 }
}
worker.port.addEventListener('message', paintMap, false);

// PUBLIC CHAT
function updatePublicChat(event) {
 if (event.data.substr(0, 4) != 'txt ') return;
 var name = event.data.substr(4).split(' ', 1)[0];
 var message = event.data.substr(4 + name.length + 1);
 // display "<name> message" in public chat
 var public = document.getElementById('public');
 var p = document.createElement('p');
 var n = document.createElement('button');
 n.textContent = '<' + name + '> ';
 n.onclick = function () { worker.port.postMessage('msg ' + name); };
 p.appendChild(n);
 var m = document.createElement('span');
 m.textContent = message;
 p.appendChild(m);
 public.appendChild(p);
}
worker.port.addEventListener('message', updatePublicChat, false);

// PRIVATE CHAT
function startPrivateChat(event) {
 if (event.data.substr(0, 4) != 'msg ') return;
 var name = event.data.substr(4).split(' ', 1)[0];
 var port = event.ports[0];
 // display a private chat UI
 var ul = document.getElementById('private');
 var li = document.createElement('li');
 var h3 = document.createElement('h3');
 h3.textContent = 'Private chat with ' + name;
 li.appendChild(h3);

```

```
var div = document.createElement('div');
var addMessage = function(name, message) {
 var p = document.createElement('p');
 var n = document.createElement('strong');
 n.textContent = '<' + name + '> ';
 p.appendChild(n);
 var t = document.createElement('span');
 t.textContent = message;
 p.appendChild(t);
 div.appendChild(p);
};
port.onmessage = function (event) {
 addMessage(name, event.data);
};
li.appendChild(div);
var form = document.createElement('form');
var p = document.createElement('p');
var input = document.createElement('input');
input.size = 50;
p.appendChild(input);
p.appendChild(document.createTextNode(' '));
var button = document.createElement('button');
button.textContent = 'Post';
p.appendChild(button);
form.onsubmit = function () {
 port.postMessage(input.value);
 addMessage('me', input.value);
 input.value = '';
 return false;
};
form.appendChild(p);
li.appendChild(form);
ul.appendChild(li);
}
worker.port.addEventListener('message', startPrivateChat, false);

worker.port.start();
</script>
</head>
<body>
<h1>Viewer</h1>
<h2>Map</h2>
<p><canvas id="map" height=150 width=150></canvas></p>
<p>
<button type=button onclick="worker.port.postMessage('mov left')">Left</button>
<button type=button onclick="worker.port.postMessage('mov up')">Up</button>
<button type=button onclick="worker.port.postMessage('mov down')">Down</button>
```

```

<button type=button onclick="worker.port.postMessage('mov right')">Right</button>
<button type=button onclick="worker.port.postMessage('set 0')">Set 0</button>
<button type=button onclick="worker.port.postMessage('set 1')">Set 1</button>
</p>
<h2>Public Chat</h2>
<div id="public"></div>
<form onsubmit="worker.port.postMessage('txt ' + message.value); message.value='';">
 <p>
 <input type="text" name="message" size="50">
 <button>Post</button>
 </p>
</form>
<h2>Private Chat</h2>
<ul id="private">
</body>
</html>

```

There are several key things worth noting about the way the viewer is written.

**Multiple listeners.** Instead of a single message processing function, the code here attaches multiple event listeners, each one performing a quick check to see if it is relevant for the message. In this example it doesn't make much difference, but if multiple authors wanted to collaborate using a single port to communicate with a worker, it would allow for independent code instead of changes having to all be made to a single event handling function.

Registering event listeners in this way also allows you to unregister specific listeners when you are done with them, as is done with the `configure()` method in this example.

Finally, the worker:

```

var nextName = 0;
function getNextName() {
 // this could use more friendly names
 // but for now just return a number
 return nextName++;
}

var map = [
 [0, 0, 0, 0, 0, 0, 0],
 [1, 1, 0, 1, 0, 1, 1],
 [0, 1, 0, 1, 0, 0, 0],
 [0, 1, 0, 1, 0, 1, 1],
 [0, 0, 0, 1, 0, 0, 0],
 [1, 0, 0, 1, 1, 1, 1],
 [1, 1, 0, 1, 1, 0, 1],
];

```

```

function wrapX(x) {
 if (x < 0) return wrapX(x + map[0].length);
 if (x >= map[0].length) return wrapX(x - map[0].length);
 return x;
}

function wrapY(y) {
 if (y < 0) return wrapY(y + map.length);
 if (y >= map[0].length) return wrapY(y - map.length);
 return y;
}

function wrap(val, min, max) {
 if (val < min)
 return val + (max-min)+1;
 if (val > max)
 return val - (max-min)-1;
 return val;
}

function sendMapData(viewer) {
 var data = '';
 for (var y = viewer.y-1; y <= viewer.y+1; y += 1) {
 for (var x = viewer.x-1; x <= viewer.x+1; x += 1) {
 if (data != '')
 data += ',';
 data += map[wrap(y, 0, map[0].length-1)][wrap(x, 0, map.length-1)];
 }
 }
 viewer.port.postMessage('map ' + data);
}

var viewers = {};
onconnect = function (event) {
 var name = getNextName();
 event.ports[0]._data = { port: event.ports[0], name: name, x: 0, y: 0, };
 viewers[name] = event.ports[0]._data;
 event.ports[0].postMessage('cfg ' + name);
 event.ports[0].onmessage = getMessage;
 sendMapData(event.ports[0]._data);
};

function getMessage(event) {
 switch (event.data.substr(0, 4)) {
 case 'mov ':
 var direction = event.data.substr(4);
 var dx = 0;

```

```

var dy = 0;
switch (direction) {
 case 'up': dy = -1; break;
 case 'down': dy = 1; break;
 case 'left': dx = -1; break;
 case 'right': dx = 1; break;
}
event.target._data.x = wrapX(event.target._data.x + dx);
event.target._data.y = wrapY(event.target._data.y + dy);
sendMapData(event.target._data);
break;
case 'set':
 var value = event.data.substr(4);
 map[event.target._data.y][event.target._data.x] = value;
 for (var viewer in viewers)
 sendMapData(viewers[viewer]);
 break;
case 'txt':
 var name = event.target._data.name;
 var message = event.data.substr(4);
 for (var viewer in viewers)
 viewers[viewer].port.postMessage('txt ' + name + ' ' + message);
 break;
case 'msg':
 var party1 = event.target._data;
 var party2 = viewers[event.data.substr(4).split(' ', 1)[0]];
 if (party2) {
 var channel = new MessageChannel();
 party1.port.postMessage('msg ' + party2.name, [channel.port1]);
 party2.port.postMessage('msg ' + party1.name, [channel.port2]);
 }
 break;
}
}

```

Connecting to multiple pages. The script uses the [onconnect](#) event listener to listen for multiple connections.

**Direct channels.** When the worker receives a "msg" message from one viewer naming another viewer, it sets up a direct connection between the two, so that the two viewers can communicate directly without the worker having to proxy all the messages.

[View this example online.](#)

#### 10.1.2.5 Delegation

*This section is non-normative.*

With multicore CPUs becoming prevalent, one way to obtain better performance is to split computationally expensive tasks amongst multiple workers. In this example, a computationally expensive task that is to be performed for every number from 1 to 10,000,000 is farmed out to ten subworkers.

The main page is as follows, it just reports the result:

```
<!DOCTYPE HTML>
<html lang="en">
 <head>
 <meta charset="utf-8">
 <title>Worker example: Multicore computation</title>
 </head>
 <body>
 <p>Result: <output id="result"></output></p>
 <script>
 var worker = new Worker('worker.js');
 worker.onmessage = function (event) {
 document.getElementById('result').textContent = event.data;
 };
 </script>
 </body>
</html>
```

The worker itself is as follows:

```
// settings
var num_workers = 10;
var items_per_worker = 1000000;

// start the workers
var result = 0;
var pending_workers = num_workers;
for (var i = 0; i < num_workers; i += 1) {
 var worker = new Worker('core.js');
 worker.postMessage(i * items_per_worker);
 worker.postMessage((i+1) * items_per_worker);
 worker.onmessage = storeResult;
}

// handle the results
function storeResult(event) {
 result += 1*event.data;
 pending_workers -= 1;
 if (pending_workers <= 0)
 postMessage(result); // finished!
}
```

It consists of a loop to start the subworkers, and then a handler that waits for all the subworkers to respond.

The subworkers are implemented as follows:

```
var start;
onmessage = getStart;
function getStart(event) {
 start = 1*event.data;
 onmessage = getEnd;
}

var end;
function getEnd(event) {
 end = 1*event.data;
 onmessage = null;
 work();
}

function work() {
 var result = 0;
 for (var i = start; i < end; i += 1) {
 // perform some complex calculation here
 result += 1;
 }
 postMessage(result);
 close();
}
```

They receive two numbers in two events, perform the computation for the range of numbers thus specified, and then report the result back to the parent.

[View this example online.](#)

#### 10.1.2.6 Providing libraries

*This section is non-normative.*

Suppose that a cryptography library is made available that provides three tasks:

##### Generate a public/private key pair

Takes a port, on which it will send two messages, first the public key and then the private key.

##### Given a plaintext and a public key, return the corresponding ciphertext

Takes a port, to which any number of messages can be sent, the first giving the public key, and the remainder giving the plaintext, each of which is encrypted and then sent on that

same channel as the ciphertext. The user can close the port when it is done encrypting content.

#### Given a ciphertext and a private key, return the corresponding plaintext

Takes a port, to which any number of messages can be sent, the first giving the private key, and the remainder giving the ciphertext, each of which is decrypted and then sent on that same channel as the plaintext. The user can close the port when it is done decrypting content.

The library itself is as follows:

```
function handleMessage(e) {
 if (e.data == "genkeys")
 genkeys(e.ports[0]);
 else if (e.data == "encrypt")
 encrypt(e.ports[0]);
 else if (e.data == "decrypt")
 decrypt(e.ports[0]);
}

function genkeys(p) {
 var keys = _generateKeyPair();
 p.postMessage(keys[0]);
 p.postMessage(keys[1]);
}

function encrypt(p) {
 var key, state = 0;
 p.onmessage = function (e) {
 if (state == 0) {
 key = e.data;
 state = 1;
 } else {
 p.postMessage(_encrypt(key, e.data));
 }
 };
}

function decrypt(p) {
 var key, state = 0;
 p.onmessage = function (e) {
 if (state == 0) {
 key = e.data;
 state = 1;
 } else {
 p.postMessage(_decrypt(key, e.data));
 }
 };
}
```

```

 };
}

// support being used as a shared worker as well as a dedicated worker
if ('onmessage' in this) // dedicated worker
 onmessage = handleMessage;
else // shared worker
 onconnect = function (e) { e.port.onmessage = handleMessage; }

// the "crypto" functions:

function _generateKeyPair() {
 return [Math.random(), Math.random()];
}

function _encrypt(k, s) {
 return 'encrypted-' + k + ' ' + s;
}

function _decrypt(k, s) {
 return s.substr(s.indexOf(' ') + 1);
}

```

Note that the crypto functions here are just stubs and don't do real cryptography.

This library could be used as follows:

```

<!DOCTYPE HTML>
<html lang="en">
<head>
 <meta charset="utf-8">
 <title>Worker example: Crypto library</title>
 <script>
 const cryptoLib = new Worker('libcrypto-v1.js'); // or could use 'libcrypto'
 function startConversation(source, message) {
 const messageChannel = new MessageChannel();
 source.postMessage(message, [messageChannel.port2]);
 return messageChannel.port1;
 }
 function getKeys() {
 let state = 0;
 startConversation(cryptoLib, "genkeys").onmessage = function (e) {
 if (state === 0)
 document.getElementById('public').value = e.data;
 else if (state === 1)
 document.getElementById('private').value = e.data;
 }
 }
 </script>
</head>
<body>
 <input type="text" id="public" value="Public Key" />
 <input type="text" id="private" value="Private Key" />
 <button type="button" onclick="getKeys();">Get Keys</button>
</body>
</html>

```

```

 state += 1;
 };
}
function enc() {
 const port = startConversation(cryptoLib, "encrypt");
 port.postMessage(document.getElementById('public').value);
 port.postMessage(document.getElementById('input').value);
 port.onmessage = function (e) {
 document.getElementById('input').value = e.data;
 port.close();
 };
}
function dec() {
 const port = startConversation(cryptoLib, "decrypt");
 port.postMessage(document.getElementById('private').value);
 port.postMessage(document.getElementById('input').value);
 port.onmessage = function (e) {
 document.getElementById('input').value = e.data;
 port.close();
 };
}
</script>
<style>
 textarea { display: block; }
</style>
</head>
<body onload="getKeys()">
 <fieldset>
 <legend>Keys</legend>
 <p><label>Public Key: <textarea id="public"></textarea></label></p>
 <p><label>Private Key: <textarea id="private"></textarea></label></p>
 </fieldset>
 <p><label>Input: <textarea id="input"></textarea></label></p>
 <p><button onclick="enc()">Encrypt</button> <button onclick="dec()">Decrypt</button>
</body>
</html>
```

A later version of the API, though, might want to offload all the crypto work onto subworkers. This could be done as follows:

```

function handleMessage(e) {
 if (e.data == "genkeys")
 genkeys(e.ports[0]);
 else if (e.data == "encrypt")
 encrypt(e.ports[0]);
 else if (e.data == "decrypt")
 decrypt(e.ports[0]);
```

```

}

function genkeys(p) {
 var generator = new Worker('libcrypto-v2-generator.js');
 generator.postMessage('', [p]);
}

function encrypt(p) {
 p.onmessage = function (e) {
 var key = e.data;
 var encryptor = new Worker('libcrypto-v2-encryptor.js');
 encryptor.postMessage(key, [p]);
 };
}

function encrypt(p) {
 p.onmessage = function (e) {
 var key = e.data;
 var decryptor = new Worker('libcrypto-v2-decryptor.js');
 decryptor.postMessage(key, [p]);
 };
}

// support being used as a shared worker as well as a dedicated worker
if ('onmessage' in this) // dedicated worker
 onmessage = handleMessage;
else // shared worker
 onconnect = function (e) { e.ports[0].onmessage = handleMessage };


```

The little subworkers would then be as follows.

For generating key pairs:

```

onmessage = function (e) {
 var k = _generateKeyPair();
 e.ports[0].postMessage(k[0]);
 e.ports[0].postMessage(k[1]);
 close();
}

function _generateKeyPair() {
 return [Math.random(), Math.random()];
}

```

For encrypting:

```
onmessage = function (e) {
```

```

var key = e.data;
e.ports[0].onmessage = function (e) {
 var s = e.data;
 postMessage(_encrypt(key, s));
}
}

function _encrypt(k, s) {
 return 'encrypted-' + k + ' ' + s;
}

```

For decrypting:

```

onmessage = function (e) {
 var key = e.data;
 e.ports[0].onmessage = function (e) {
 var s = e.data;
 postMessage(_decrypt(key, s));
 }
}

function _decrypt(k, s) {
 return s.substr(s.indexOf(' ') + 1);
}

```

Notice how the users of the API don't have to even know that this is happening — the API hasn't changed; the library can delegate to subworkers without changing its API, even though it is accepting data using message channels.

[View this example online.](#)

### 10.1.3 Tutorials

#### 10.1.3.1 Creating a dedicated worker

*This section is non-normative.*

Creating a worker requires a URL to a JavaScript file. The [Worker\(\)](#) constructor is invoked with the URL to that file as its only argument; a worker is then created and returned:

```
var worker = new Worker('helper.js');
```

If you want your worker script to be interpreted as a [module script](#) instead of the default [classic script](#), you need to use a slightly different signature:

```
var worker = new Worker('helper.mjs', { type: "module" });
```

### 10.1.3.2 Communicating with a dedicated worker

*This section is non-normative.*

Dedicated workers use [MessagePort](#) objects behind the scenes, and thus support all the same features, such as sending structured data, transferring binary data, and transferring other ports.

To receive messages from a dedicated worker, use the [onmessage](#) event handler IDL attribute on the [Worker](#) object:

```
worker.onmessage = function (event) { ... };
```

You can also use the [addEventListener\(\)](#) method.

The implicit [MessagePort](#) used by dedicated workers has its [port message queue](#) implicitly enabled when it is created, so there is no equivalent to the [MessagePort](#) interface's [start\(\)](#) method on the [Worker](#) interface.

To *send* data to a worker, use the [postMessage\(\)](#) method. Structured data can be sent over this communication channel. To send [ArrayBuffer](#) objects efficiently (by transferring them rather than cloning them), list them in an array in the second argument.

```
worker.postMessage({
 operation: 'find-edges',
 input: buffer, // an ArrayBuffer object
 threshold: 0.6,
}, [buffer]);
```

To receive a message inside the worker, the [onmessage](#) event handler IDL attribute is used.

```
onmessage = function (event) { ... };
```

You can again also use the [addEventListener\(\)](#) method.

In either case, the data is provided in the event object's [data](#) attribute.

To send messages back, you again use [postMessage\(\)](#). It supports the structured data in the same manner.

```
postMessage(event.data.input, [event.data.input]); // transfer the buffer back
```

### 10.1.3.3 Shared workers

MDN

[SharedWorker](#)

Firefox 29 + Safari 5 – 7 Chrome 4 +

---

Opera 10.6 + Edge 79 +

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 33 + Safari iOS 5 – 7 Chrome Android No WebView Android No Samsung Internet 4.0 – 5.0 Opera Android 11 – 14

*This section is non-normative.*

Shared workers are identified by the URL of the script used to create it, optionally with an explicit name. The name allows multiple instances of a particular shared worker to be started.

Shared workers are scoped by [origin](#). Two different sites using the same names will not collide. However, if a page tries to use the same shared worker name as another page on the same site, but with a different script URL, it will fail.

Creating shared workers is done using the [`SharedWorker\(\)`](#) constructor. This constructor takes the URL to the script to use for its first argument, and the name of the worker, if any, as the second argument.

```
var worker = new SharedWorker('service.js');
```

Communicating with shared workers is done with explicit [`MessagePort`](#) objects. The object returned by the [`SharedWorker\(\)`](#) constructor holds a reference to the port on its [port](#) attribute.

```
worker.port.onmessage = function (event) { ... };
worker.port.postMessage('some message');
worker.port.postMessage({ foo: 'structured', bar: ['data', 'also', 'possible']}
```

Inside the shared worker, new clients of the worker are announced using the [connect](#) event. The port for the new client is given by the event object's [source](#) attribute.

```
onconnect = function (event) {
 var newPort = event.source;
 // set up a listener
 newPort.onmessage = function (event) { ... };
 // send a message back to the port
 newPort.postMessage('ready!'); // can also send structured data, of course
};
```

## 10.2 Infrastructure

This standard defines two kinds of workers: dedicated workers, and shared workers. Dedicated workers, once created, are linked to their creator, but message ports can be used to communicate from a dedicated worker to multiple other browsing contexts or workers. Shared workers, on the other hand, are named, and once created any script running in the same [origin](#) can obtain a reference to that worker and communicate with it. *Service Workers* defines a third

kind. [\[SW\]](#)

### 10.2.1 The global scope

The global scope is the "inside" of a worker.

#### 10.2.1.1 The [WorkerGlobalScope](#) common interface



#### [WorkerGlobalScope](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera 10.6+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

[Exposed=Worker]

```
interface WorkerGlobalScope : EventTarget {
 readonly attribute WorkerGlobalScope self;
 readonly attribute WorkerLocation location;
 readonly attribute WorkerNavigator navigator;
 undefined importScripts(USVString... urls);

 attribute OnErrorHandler onerror;
 attribute EventHandler onlanguagechange;
 attribute EventHandler onoffline;
 attribute EventHandler ononline;
 attribute EventHandler onrejectionhandled;
 attribute EventHandler onunhandledrejection;
};
```

[WorkerGlobalScope](#) serves as the base class for specific types of worker global scope objects, including [DedicatedWorkerGlobalScope](#), [SharedWorkerGlobalScope](#), and [ServiceWorkerGlobalScope](#).

A [WorkerGlobalScope](#) object has an associated *owner set* (a [set](#) of [Document](#) and [WorkerGlobalScope](#) objects). It is initially empty and populated when the worker is created or obtained.

It is a [set](#), instead of a single owner, to accommodate [SharedWorkerGlobalScope](#) objects.

A [WorkerGlobalScope](#) object has an associated *type* ("classic" or "module"). It is set

during creation.

A [WorkerGlobalScope](#) object has an associated *url* (null or a [URL](#)). It is initially null.

A [WorkerGlobalScope](#) object has an associated *name* (a string). It is set during creation.

The *name* can have different semantics for each subclass of [WorkerGlobalScope](#). For [DedicatedWorkerGlobalScope](#) instances, it is simply a developer-supplied name, useful mostly for debugging purposes. For [SharedWorkerGlobalScope](#) instances, it allows obtaining a reference to a common shared worker via the [SharedWorker\(\)](#) constructor. For [ServiceWorkerGlobalScope](#) objects, it doesn't make sense (and as such isn't exposed through the JavaScript API at all).

A [WorkerGlobalScope](#) object has an associated *policy container* (a [policy container](#)). It is initially a new [policy container](#).

A [WorkerGlobalScope](#) object has an associated *embedder policy* (an [embedder policy](#)).

A [WorkerGlobalScope](#) object has an associated *module map*. It is a [module map](#), initially empty.

A [WorkerGlobalScope](#) object has an associated *cross-origin isolated capability* boolean. It is initially false.

## **`workerGlobal.self`**



### [WorkerGlobalScope/self](#)

Support in all current engines.

---

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera 11.5+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 34+ Safari iOS 5+ Chrome Android 40+ WebView Android 37+ Samsung

---

Internet 4.0+ Opera Android Yes

Returns `workerGlobal`.

## **`workerGlobal.location`**



### [WorkerGlobalScope/location](#)

Support in all current engines.

---

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera11.5+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android40+WebView Android37+Samsung Internet4.0+Opera AndroidYes

Returns *workerGlobal*'s [WorkerLocation](#) object.

## ***workerGlobal.navigator***

✓MDN

[WorkerGlobalScope/navigator](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

---

Opera11.5+Edge79+

---

Edge (Legacy)17+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android40+WebView Android37+Samsung

Internet4.0+Opera AndroidYes

Returns *workerGlobal*'s [WorkerNavigator](#) object.

## ***workerGlobal.importScripts(...urls)***

✓MDN

[WorkerGlobalScope/importScripts](#)

Support in all current engines.

Firefox4+Safari4+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android11+

Fetches each [URL](#) in *urls*, executes them one-by-one in the order they are passed, and then returns (or throws if something went amiss).

The *self* attribute must return the [WorkerGlobalScope](#) object itself.

The *location* attribute must return the [WorkerLocation](#) object whose associated [WorkerGlobalScope](#) object is the [WorkerGlobalScope](#) object.

While the [WorkerLocation](#) object is created after the [WorkerGlobalScope](#) object, this is not problematic as it cannot be observed from script.

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by objects implementing the

## [WorkerGlobalScope](#) interface:

	<a href="#">Event handler</a>	<a href="#">Event handler event type</a>		
<i>onerror</i>	 MDN			
	<a href="#">WorkerGlobalScope/onerror</a>			
	Support in all current engines.	<a href="#">error</a>		
Firefox	3.5+	Safari 4+	Chrome 4+	
Opera	11.5+	Edge 79+		
Edge (Legacy)	12+	Internet Explorer 10+		
Firefox	Android 4+	Safari iOS 5+	Chrome Android 40+	WebView
Android	37+	Samsung Internet 4.0+	Opera Android Yes	
<i>onlanguagechange</i>	 MDN			
	<a href="#">WorkerGlobalScope/onlanguagechange</a>			
	Support in all current engines.	<a href="#">languagechange</a>		
Firefox	74+	Safari 4+	Chrome 4+	
Opera	11.5+	Edge 79+		
Edge (Legacy)	12+	Internet Explorer Yes		
Firefox	Android No	Safari iOS 5+	Chrome Android 40+	WebView
Android	37+	Samsung Internet 4.0+	Opera Android Yes	
<i>onoffline</i>	 MDN			
	<a href="#">WorkerGlobalScope/onoffline</a>			
	Support in all current engines.	<a href="#">offline</a>		
Firefox	29+	Safari 8+	Chrome 4+	
Opera	? Edge 79+			
Edge (Legacy)	No	Internet Explorer No		
Firefox	Android 29+	Safari iOS 8+	Chrome Android 40+	WebView
Android	40+	Samsung Internet 4.0+	Opera Android?	
<i>ononline</i>	 MDN			
	<a href="#">WorkerGlobalScope/ononline</a>			
	Support in all current engines.	<a href="#">online</a>		

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
<a href="#">WorkerGlobalScope/ononline</a>	
Support in all current engines.	
Firefox 29+ Safari 8+ Chrome 4+	
Opera? Edge 79+	
Edge (Legacy) No Internet Explorer No	
Firefox Android 29+ Safari iOS 8+ Chrome Android 40+ WebView Android 40+ Samsung Internet 4.0+ Opera Android?	
<i>onrejectionhandled</i>	<a href="#">rejectionhandled</a>
<i>onunhandledrejection</i>	<a href="#">unhandledrejection</a>

#### 10.2.1.2 Dedicated workers and the [DedicatedWorkerGlobalScope](#) interface



#### [DedicatedWorkerGlobalScope](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

```
[Global=(Worker,DedicatedWorker), Exposed=DedicatedWorker]
interface DedicatedWorkerGlobalScope : WorkerGlobalScope {
 [Replaceable] readonly attribute DOMString name;
 undefined postMessage(any message, sequence<object> transfer);
 undefined postMessage(any message, optional StructuredSerializeOptions options);
 undefined close();
 attribute EventHandler onmessage;
 attribute EventHandler onmessageerror;
};
```

[DedicatedWorkerGlobalScope](#) objects act as if they had an implicit [MessagePort](#) associated with them. This port is part of a channel that is set up when the worker is created, but it is not exposed. This object must never be garbage collected before the

[DedicatedWorkerGlobalScope](#) object.

All messages received by that port must immediately be retargeted at the [DedicatedWorkerGlobalScope](#) object.

### ***dedicatedWorkerGlobal.name***

✓MDN

[DedicatedWorkerGlobalScope/name](#)

Support in all current engines.

Firefox 55+ Safari 12.1+ Chrome 71+

---

Opera 58+ Edge 79+

---

Edge (Legacy) 18 Internet Explorer No

---

Firefox Android 55+ Safari iOS 12.2+ Chrome Android 71+ WebView Android 71+ Samsung Internet 10.0+ Opera Android 50+

Returns *dedicatedWorkerGlobal*'s [name](#), i.e. the value given to the [Worker](#) constructor.  
Primarily useful for debugging.

### ***dedicatedWorkerGlobal.postMessage(message [, transfer ])***

✓MDN

[DedicatedWorkerGlobalScope/postMessage](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera 10.6+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

### ***dedicatedWorkerGlobal.postMessage(message [, { transfer } ])***

Clones *message* and transmits it to the [Worker](#) object associated with *dedicatedWorkerGlobal*. *transfer* can be passed as a list of objects that are to be transferred rather than cloned.

### ***dedicatedWorkerGlobal.close()***

✓MDN

[DedicatedWorkerGlobalScope/close](#)

Support in all current engines.

---

Firefox3.5+Safari4+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

Aborts *dedicatedWorkerGlobal*.

The ***name*** getter steps are to return [this's name](#). Its value represents the name given to the worker using the [Worker](#) constructor, used primarily for debugging purposes.

The [postMessage\(message, transfer\)](#) and [postMessage\(message, options\)](#) methods on [DedicatedWorkerGlobalScope](#) objects act as if, when invoked, it immediately invoked the respective [postMessage\(message, transfer\)](#) and [postMessage\(message, options\)](#) on the port, with the same arguments, and returned the same return value.

To *close a worker*, given a *workerGlobal*, run these steps:

1. Discard any [tasks](#) that have been added to *workerGlobal*'s [relevant agent's event loop's task queues](#).
2. Set *workerGlobal*'s [closing](#) flag to true. (This prevents any further tasks from being queued.)

The [close\(\)](#) method steps are to [close a worker](#) given [this](#).

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by objects implementing the [DedicatedWorkerGlobalScope](#) interface:

*onmessage*

[Event handler](#)

[Event handler event type](#)



[DedicatedWorkerGlobalScope/onmessage](#)

Support in all current engines.

[message](#)

---

Firefox3.5+Safari4+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

<a href="#">Event handler</a>	<a href="#">Event handler</a> event type
<i>onmessageerror</i>	

MDN

## [DedicatedWorkerGlobalScope/onmessageerror](#)

Firefox 57+ Safari No Chrome 60+	<a href="#">messageerror</a>
Opera 47+ Edge 79+	
Edge (Legacy) 18 Internet Explorer No	
Firefox Android 57+ Safari iOS No Chrome Android 60+ WebView Android 60+ Samsung Internet 8.0+ Opera Android 44+	

### 10.2.1.3 Shared workers and the [SharedWorkerGlobalScope](#) interface



## [SharedWorkerGlobalScope](#)

Support in all current engines.

Firefox 29+ Safari 5+ Chrome 4+	
Opera 10.6+ Edge 79+	
Edge (Legacy) No Internet Explorer No	
Firefox Android 29+ Safari iOS 7+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+	

```
[Global=(Worker,SharedWorker),Exposed=SharedWorker]
interface SharedWorkerGlobalScope : WorkerGlobalScope {
 [Replaceable] readonly attribute DOMString name;
 undefined close\(\);
 attribute EventHandler onconnect;
};
```

A [SharedWorkerGlobalScope](#) object has an associated *constructor origin*, *constructor url*, and *credentials*. They are initialized when the [SharedWorkerGlobalScope](#) object is created, in the [run a worker](#) algorithm.

Shared workers receive message ports through [connect](#) events on their [SharedWorkerGlobalScope](#) object for each connection.

## [sharedWorkerGlobal.name](#)



## [SharedWorkerGlobalScope/name](#)

Firefox 55+ Safari No Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 55+ Safari iOS No Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

Returns *sharedWorkerGlobal*'s [name](#), i.e. the value given to the [SharedWorker](#) constructor. Multiple [SharedWorker](#) objects can correspond to the same shared worker (and [SharedWorkerGlobalScope](#)), by reusing the same name.

## **[sharedWorkerGlobal.close\(\)](#)**

✓MDN

### [SharedWorkerGlobalScope/close](#)

Support in all current engines.

Firefox 29+ Safari 5+ Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 29+ Safari iOS 7+ Chrome Android 18+ WebView Android 37+ Samsung

Internet 1.0+ Opera Android 11+

Aborts *sharedWorkerGlobal*.

The *name* getter steps are to return [this's name](#). Its value represents the name that can be used to obtain a reference to the worker using the [SharedWorker](#) constructor.

The *close()* method steps are to [close a worker](#) given [this](#).

---

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by objects implementing the [SharedWorkerGlobalScope](#) interface:

[Event handler](#)

[Event handler event type](#)

*onconnect*

MDN

[connect](#)

[SharedWorkerGlobalScope/onconnect](#)

Firefox 29+ Safari No Chrome 4+

	<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
Opera 10.6+ / Edge 79+		
Edge (Legacy)	No	Internet Explorer
Firefox	Android 29+	Safari iOS
	Chrome Android 18+	WebView
Android 37+	Samsung Internet 1.0+	Opera Android 11+

## 10.2.2 The event loop

A [worker event loop](#)'s [task queues](#) only have events, callbacks, and networking activity as [tasks](#). These [worker event loops](#) are created by the [run a worker](#) algorithm.

Each [WorkerGlobalScope](#) object has a *closing* flag, which must be initially false, but which can get set to true by the algorithms in the processing model section below.

Once the [WorkerGlobalScope](#)'s [closing](#) flag is set to true, the [event loop](#)'s [task queues](#) must discard any further [tasks](#) that would be added to them (tasks already on the queue are unaffected except where otherwise specified). Effectively, once the [closing](#) flag is true, timers stop firing, notifications for all pending background operations are dropped, etc.

## 10.2.3 The worker's lifetime

Workers communicate with other workers and with [browsing contexts](#) through [message channels](#) and their [MessagePort](#) objects.

Each [WorkerGlobalScope](#) object *worker global scope* has a list of *the worker's ports*, which consists of all the [MessagePort](#) objects that are entangled with another port and that have one (but only one) port owned by *worker global scope*. This list includes the implicit [MessagePort](#) in the case of [dedicated workers](#).

Given an [environment settings object](#) *o* when creating or obtaining a worker, the *relevant owner to add* depends on the type of [global object](#) specified by *o*. If *o* specifies a [global object](#) that is a [WorkerGlobalScope](#) object (i.e., if we are creating a nested dedicated worker), then the relevant owner is that global object. Otherwise, *o* specifies a [global object](#) that is a [Window](#) object, and the relevant owner is the [responsible document](#) specified by *o*.

---

A worker is said to be a *permissible worker* if its [WorkerGlobalScope](#)'s [owner set](#) is not [empty](#) or:

- its [owner set](#) has been [empty](#) for no more than a short [implementation-defined](#) timeout value,
- its [WorkerGlobalScope](#) object is a [SharedWorkerGlobalScope](#) object (i.e., the worker is a shared worker), and
- the user agent has a [browsing context](#) whose [Document](#) object is not [completely loaded](#).

The second part of this definition allows a shared worker to survive for a short time while a page is loading, in case that page is going to contact the shared worker again. This can be used by user agents as a way to avoid the cost of restarting a shared worker used by a site when the user is navigating from page to page within that site.

A worker is said to be an *active needed worker* if any its [owners](#) are either [Document](#) objects that are [fully active](#) or [active needed workers](#).

A worker is said to be a *protected worker* if it is an [active needed worker](#) and either it has outstanding timers, database transactions, or network connections, or its list of [the worker's ports](#) is not empty, or its [WorkerGlobalScope](#) is actually a [SharedWorkerGlobalScope](#) object (i.e., the worker is a shared worker).

A worker is said to be a *suspendable worker* if it is not an [active needed worker](#) but it is a [permissible worker](#).

#### 10.2.4 Processing model

When a user agent is to *run a worker* for a script with [Worker](#) or [SharedWorker](#) object *worker*, [URL url](#), [environment settings object outside settings](#), [MessagePort outside port](#), and a [WorkerOptions](#) dictionary *options*, it must run the following steps.

1. Let *is shared* be true if *worker* is a [SharedWorker](#) object, and false otherwise.
2. Let *owner* be the [relevant owner to add](#) given *outside settings*.
3. Let *parent worker global scope* be null.
4. If *owner* is a [WorkerGlobalScope](#) object (i.e., we are creating a nested dedicated worker), then set *parent worker global scope* to *owner*.
5. Let *agent* be the result of [obtaining a dedicated/shared worker agent](#) given *outside settings* and *is shared*. Run the rest of these steps in that agent.

For the purposes of timing APIs, this is the *official moment of creation* of the worker.

6. Let *realm execution context* be the result of [creating a new JavaScript realm](#) given *agent* and the following customizations:
  - For the global object, if *is shared* is true, create a new [SharedWorkerGlobalScope](#) object. Otherwise, create a new [DedicatedWorkerGlobalScope](#) object.
7. Let *worker global scope* be the [global object](#) of *realm execution context*'s Realm component.

This is the [DedicatedWorkerGlobalScope](#) or [SharedWorkerGlobalScope](#) object

created in the previous step.

8. Set up a worker environment settings object with *realm execution context* and *outside settings*, and let *inside settings* be the result.
9. Set worker global scope's [name](#) to the value of *options*'s **name** member.
10. Append *owner* to worker global scope's [owner set](#).
11. If *is shared* is true, then:
  1. Set worker global scope's [constructor origin](#) to *outside settings*'s [origin](#).
  2. Set worker global scope's [constructor url](#) to *url*.
  3. Set worker global scope's [type](#) to the value of *options*'s **type** member.
  4. Set worker global scope's [credentials](#) to the value of *options*'s **credentials** member.
12. Let *destination* be "sharedworker" if *is shared* is true, and "worker" otherwise.
13. Obtain *script* by switching on the value of *options*'s **type** member:

**"classic"**

[Fetch a classic worker script](#) given *url*, *outside settings*, *destination*, and *inside settings*.

**"module"**

[Fetch a module worker script graph](#) given *url*, *outside settings*, *destination*, the value of the **credentials** member of *options*, and *inside settings*.

In both cases, to [perform the fetch](#) given *request*, perform the following steps if the [is top-level](#) flag is set:

1. Set *request*'s [reserved client](#) to *inside settings*.
2. [Fetch](#) *request*, and asynchronously wait to run the remaining steps as part of *fetch*'s [process response](#) for the [response](#) *response*.
3. Set worker global scope's [url](#) to *response*'s [url](#).
4. [Initialize worker global scope's policy container](#) given worker global scope, *response*, and *inside settings*.
5. If the [Run CSP initialization for a global object](#) algorithm returns "Blocked" when executed upon worker global scope, set *response* to a [network error](#). [CSP]

6. If *worker global scope's embedder policy's value* is [compatible with cross-origin isolation](#) and *is shared* is true, then set *agent's agent cluster's cross-origin isolation mode* to "[logical](#)" or "[concrete](#)". The one chosen is [implementation-defined](#).

This really ought to be set when the agent cluster is created, which requires a redesign of this section.

7. If the result of [checking a global object's embedder policy](#) with *worker global scope*, *outside settings*, and *response* is false, then set *response* to a [network error](#).
8. Set *worker global scope's cross-origin isolated capability* to true if *agent's agent cluster's cross-origin isolation mode* is "[concrete](#)".
9. If *is shared* is false and *owner's cross-origin isolated capability* is false, then set *worker global scope's cross-origin isolated capability* to false.
10. If *is shared* is false and *response's url's scheme* is "[data](#)", then set *worker global scope's cross-origin isolated capability* to false.

This is a conservative default for now, while we figure out how workers in general, and [data:](#) URL workers in particular (which are cross-origin from their owner), will be treated in the context of permissions policies. See [w3c/webappsec-permissions-policy issue #207](#) for more details.

11. Asynchronously complete the [perform the fetch](#) steps with *response*.

If the algorithm asynchronously completes with null or with a *script* whose [error to rethrow](#) is non-null, then:

1. [Queue a global task](#) on the [DOM manipulation task source](#) given *worker's relevant global object* to [fire an event](#) named [error](#) at *worker*.
2. Run the [environment discarding steps](#) for *inside settings*.
3. Return.

Otherwise, continue the rest of these steps after the algorithm's asynchronous completion, with *script* being the asynchronous completion value.

14. Associate *worker* with *worker global scope*.
15. Let *inside port* be a [new MessagePort](#) object in *inside settings's Realm*.
16. Associate *inside port* with *worker global scope*.
17. [Entangle](#) *outside port* and *inside port*.

18. Create a new [WorkerLocation](#) object and associate it with *worker global scope*.
19. **Closing orphan workers:** Start monitoring the worker such that no sooner than it stops being a [protected worker](#), and no later than it stops being a [permissible worker](#), *worker global scope's closing* flag is set to true.
20. **Suspending workers:** Start monitoring the worker, such that whenever *worker global scope's closing* flag is false and the worker is a [suspendable worker](#), the user agent suspends execution of script in that worker until such time as either the [closing](#) flag switches to true or the worker stops being a [suspendable worker](#).
21. Set *inside settings*'s [execution ready flag](#).
22. If *script* is a [classic script](#), then [run the classic script](#) *script*. Otherwise, it is a [module script](#); [run the module script](#) *script*.

In addition to the usual possibilities of returning a value or failing due to an exception, this could be [prematurely aborted](#) by the [terminate a worker](#) algorithm defined below.

23. Enable *outside port*'s [port message queue](#).
24. If *is shared* is false, enable the [port message queue](#) of the worker's implicit port.
25. If *is shared* is true, then [queue a global task](#) on [DOM manipulation task source](#) given *worker global scope* to [fire an event](#) named [connect](#) at *worker global scope*, using [MessageEvent](#), with the [data](#) attribute initialized to the empty string, the [ports](#) attribute initialized to a new [frozen array](#) containing *inside port*, and the [source](#) attribute initialized to *inside port*.
26. Enable the [client message queue](#) of the [ServiceWorkerContainer](#) object whose associated [service worker client](#) is *worker global scope's relevant settings object*.
27. **Event loop:** Run the [responsible event loop](#) specified by *inside settings* until it is destroyed.

The handling of events or the execution of callbacks by [tasks](#) run by the [event loop](#) might get [prematurely aborted](#) by the [terminate a worker](#) algorithm defined below.

The worker processing model remains on this step until the event loop is destroyed, which happens after the [closing](#) flag is set to true, as described in the [event loop](#) processing model.

28. [Clear](#) the *worker global scope's map of active timers*.
  29. Disentangle all the ports in the list of [the worker's ports](#).
  30. [Empty](#) *worker global scope's owner set*.
-

When a user agent is to *terminate a worker* it must run the following steps [in parallel](#) with the worker's main loop (the "[run a worker](#)" processing model defined above):

1. Set the worker's [WorkerGlobalScope](#) object's [closing](#) flag to true.
2. If there are any [tasks](#) queued in the [WorkerGlobalScope](#) object's [relevant agent's event loop's task queues](#), discard them without processing them.
3. [Abort the script](#) currently running in the worker.
4. If the worker's [WorkerGlobalScope](#) object is actually a [DedicatedWorkerGlobalScope](#) object (i.e. the worker is a dedicated worker), then empty the [port message queue](#) of the port that the worker's implicit port is entangled with.

User agents may invoke the [terminate a worker](#) algorithm when a worker stops being an [active needed worker](#) and the worker continues executing even after its [closing](#) flag was set to true.

#### 10.2.5 Runtime script errors

Whenever an uncaught runtime script error occurs in one of the worker's scripts, if the error did not occur while handling a previous script error, the user agent must [report the error](#) for that [script](#), with the position (line number and column number) where the error occurred, using the [WorkerGlobalScope](#) object as the target.

For shared workers, if the error is still [not handled](#) afterwards, the error may be reported to a developer console.

For dedicated workers, if the error is still [not handled](#) afterwards, the user agent must [queue a task](#) to run these steps:

1. Let *notHandled* be the result of [firing an event named error](#) at the [Worker](#) object associated with the worker, using [ErrorEvent](#), with the [cancelable](#) attribute initialized to true, the [message](#), [filename](#), [lineno](#), and [colno](#) attributes initialized appropriately, and the [error](#) attribute initialized to null.
2. If *notHandled* is true, then the user agent must act as if the uncaught runtime script error had occurred in the global scope that the [Worker](#) object is in, thus repeating the entire runtime script error reporting process one level up.

If the implicit port connecting the worker to its [Worker](#) object has been disentangled (i.e. if the parent worker has been terminated), then the user agent must act as if the [Worker](#) object had no [error](#) event handler and as if that worker's [onerror](#) attribute was null, but must otherwise act as described above.

Thus, error reports propagate up to the chain of dedicated workers up to the original [Document](#), even if some of the workers along this chain have been terminated and garbage

collected.

The [task source](#) for the task mentioned above is the [DOM manipulation task source](#).

## 10.2.6 Creating workers

### 10.2.6.1 The [AbstractWorker](#) mixin

```
interface mixin AbstractWorker {
 attribute EventHandler onerror;
};
```

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by objects implementing the [AbstractWorker](#) interface:

	<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
<i>onerror</i>	<a href="#">ServiceWorker/onerror</a>	

[ServiceWorker/onerror](#)

Support in all current engines.

Firefox 44+ Safari 11.1+ Chrome 40+

---

Opera 27+ Edge 79+

---

Edge (Legacy) 17+ Internet Explorer No

---

Firefox Android 44+ Safari iOS 11.3+ Chrome Android 40+ WebView  
Android 40+ Samsung Internet 4.0+ Opera Android 27+

[SharedWorker/onerror](#)

[error](#)

Firefox 29+ Safari 5–7 Chrome 4+

---

Opera 10.6+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 33+ Safari iOS 5–7 Chrome Android No WebView  
Android No Samsung Internet 4.0–5.0 Opera Android 11–14

[Worker/onerror](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera 10.6+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

<a href="#">Event handler</a>	<a href="#">Event handler event type</a>
Firefox Android4+Safari iOS5+Chrome Android18+WebView Android4+Samsung Internet1.0+Opera Android11+	

#### 10.2.6.2 Script settings for workers

To set up a worker environment settings object, given a [JavaScript execution context](#) execution context and [environment settings object](#) outside settings:

1. Let *inherited origin* be *outside settings's origin*.
2. Let *realm* be the value of *execution context's Realm component*.
3. Let *worker global scope* be *realm's global object*.
4. Let *settings object* be a new [environment settings object](#) whose algorithms are defined as follows:

The [realm execution context](#)

Return *execution context*.

The [module map](#)

Return *worker global scope's module map*.

The [responsible document](#)

Not applicable (the [responsible event loop](#) is not a [window event loop](#)).

The [API URL character encoding](#)

Return [UTF-8](#).

The [API base URL](#)

Return *worker global scope's url*.

The [origin](#)

Return a unique [opaque origin](#) if *worker global scope's url's scheme* is "data", and *inherited origin* otherwise.

The [policy container](#)

Return *worker global scope's policy container*.

## The [cross-origin isolated capability](#)

Return worker *global scope's* [cross-origin isolated capability](#).

5. Set *settings object's* [id](#) to a new unique opaque string, [creation URL](#) to *worker global scope's* [url](#), [top-level creation URL](#) to null, [target browsing context](#) to null, and [active service worker](#) to null.
6. If *worker global scope* is a [DedicatedWorkerGlobalScope](#) object, then set *settings object's* [top-level origin](#) to *outside settings's* [top-level origin](#).
7. Otherwise, set *settings object's* [top-level origin](#) to an [implementation-defined](#) value.  
See [Client-Side Storage Partitioning](#) for the latest on properly defining this.
8. Set *realm*'s [[HostDefined]] field to *settings object*.
9. Return *settings object*.

### 10.2.6.3 Dedicated workers and the [Worker](#) interface



#### [Worker](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera 10.6+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 4+ Samsung Internet 1.0+ Opera Android 11+

```
[Exposed=(Window,DedicatedWorker,SharedWorker)]
interface Worker : EventTarget {
 constructor(USVString scriptURL, optional WorkerOptions options = {});
 undefined terminate();
 undefined postMessage(any message, sequence<object> transfer);
 undefined postMessage(any message, optional StructuredSerializeOptions options);
 attribute EventHandler onmessage;
 attribute EventHandler onmessageerror;
};

dictionary WorkerOptions {
 WorkerType type = "classic";
}
```

```
RequestCredentials credentials = "same-origin"; // credentials is only used
DOMString name = "";
};

enum WorkerType { "classic", "module" };

Worker includes AbstractWorker;

worker = new Worker(scriptURL [, options])
```

✓MDN

## [Worker/Worker](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android4+Samsung

Internet1.0+Opera Android11+

Returns a new [Worker](#) object. *scriptURL* will be fetched and executed in the background, creating a new global environment for which *worker* represents the communication channel. *options* can be used to define the [name](#) of that global environment via the [name](#) option, primarily for debugging purposes. It can also ensure this new global environment supports JavaScript modules (specify [type: "module"](#)), and if that is specified, can also be used to specify how *scriptURL* is fetched through the [credentials](#) option.

## [worker.terminate\(\)](#)

✓MDN

## [Worker/terminate](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android4+Samsung

Internet1.0+Opera Android11+

Aborts *worker*'s associated global environment.

## [worker.postMessage\(message \[, transfer \]\)](#)

✓MDN

## [Worker/postMessage](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

---

Opera10.6+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android4+Samsung Internet1.0+Opera Android11+

**`worker.postMessage(message [, { transfer } ])`**

Clones *message* and transmits it to *worker*'s global environment. *transfer* can be passed as a list of objects that are to be transferred rather than cloned.

The **`terminate()`** method, when invoked, must cause the [terminate a worker](#) algorithm to be run on the worker with which the object is associated.

[Worker](#) objects act as if they had an implicit [MessagePort](#) associated with them. This port is part of a channel that is set up when the worker is created, but it is not exposed. This object must never be garbage collected before the [Worker](#) object.

All messages received by that port must immediately be retargeted at the [Worker](#) object.

The **`postMessage(message, transfer)`** and **`postMessage(message, options)`** methods on [Worker](#) objects act as if, when invoked, they immediately invoked the respective [postMessage\(message, transfer\)](#) and [postMessage\(message, options\)](#) on the port, with the same arguments, and returned the same return value.

The [postMessage\(\)](#) method's first argument can be structured data:

`worker.postMessage({opcode: 'activate', device: 1938, parameters: [23, 102]})`

The following are the [event handlers](#) (and their corresponding [event handler event types](#)) that must be supported, as [event handler IDL attributes](#), by objects implementing the [Worker](#) interface:

### [Event handler](#)

### [Event handler event type](#)

*onmessage*



## [Worker/onmessage](#)

### [message](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

<a href="#">Event handler</a>	<a href="#">Event handler</a> <a href="#">event type</a>
Opera 10.6+ Edge 79+	
Edge (Legacy) 12+ Internet Explorer 10+	
Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 4+ Samsung Internet 1.0+ Opera Android 11+	
<i>onmessageerror</i>	
<a href="#">MDN</a>	

## [Worker](#)/[onmessageerror](#)

Firefox 57+ Safari No Chrome 60+	<a href="#">messageerror</a>
Opera 47+ Edge 79+	
Edge (Legacy) 18 Internet Explorer No	
Firefox Android 57+ Safari iOS No Chrome Android 60+ WebView Android 60+ Samsung Internet 8.0+ Opera Android 44+	

When the *Worker(scriptURL, options)* constructor is invoked, the user agent must run the following steps:

1. The user agent may throw a ["SecurityError" DOMException](#) if the request violates a policy decision (e.g. if the user agent is configured to not allow the page to start dedicated workers).

2. Let *outside settings* be the [current settings object](#).

3. [Parse](#) the *scriptURL* argument relative to *outside settings*.

4. If this fails, throw a ["SyntaxError" DOMException](#).

5. Let *worker URL* be the [resulting URL record](#).

Any [same-origin](#) URL (including [blob:](#) URLs) can be used. [data:](#) URLs can also be used, but they create a worker with an [opaque origin](#).

6. Let *worker* be a new [Worker](#) object.

7. Let *outside port* be a [new MessagePort](#) in *outside settings's Realm*.

8. Associate the *outside port* with *worker*.

9. Run this step [in parallel](#):

1. [Run a worker](#) given *worker*, *worker URL*, *outside settings*, *outside port*, and *options*.

10. Return *worker*.

#### 10.2.6.4 Shared workers and the [SharedWorker](#) interface

MDN

##### [SharedWorker](#)

Firefox 29+ Safari 5–7 Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 33+ Safari iOS 5–7 Chrome Android No WebView Android No Samsung Internet 4.0–5.0 Opera Android 11–14

[Exposed=Window]

```
interface SharedWorker : EventTarget {
 constructor(scriptURL, optional (DOMString or WorkerOptions) options);

 readonly attribute MessagePort port;
};
SharedWorker includes AbstractWorker;
```

**sharedWorker = new SharedWorker(scriptURL [, name ])**

MDN

##### [SharedWorker/SharedWorker](#)

Firefox 29+ Safari 5–7 Chrome 4+

Opera 10.6+ Edge 79+

Edge (Legacy) No Internet Explorer No

Firefox Android 33+ Safari iOS 5–7 Chrome Android No WebView Android No Samsung Internet 4.0–5.0 Opera Android 11–14

Returns a new [SharedWorker](#) object. *scriptURL* will be fetched and executed in the background, creating a new global environment for which *sharedWorker* represents the communication channel. *name* can be used to define the [name](#) of that global environment.

**sharedWorker = new SharedWorker(scriptURL [, options ])**

Returns a new [SharedWorker](#) object. *scriptURL* will be fetched and executed in the background, creating a new global environment for which *sharedWorker* represents the communication channel. *options* can be used to define the [name](#) of that global environment via the **name** option. It can also ensure this new global environment supports JavaScript modules (specify **type: "module"**), and if that is specified, can also be used to specify how *scriptURL* is fetched through the **credentials** option. Note that attempting to

construct a shared worker with *options* whose **type** or **credentials** values mismatch an existing shared worker will cause the returned *sharedWorker* to fire an error event and not connect to the existing shared worker.

## ***sharedWorker*.[port](#)**

MDN

### [SharedWorker/port](#)

Firefox 29 + Safari 5 – 7 Chrome 4 +

---

Opera 10.6 + Edge 79 +

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 33 + Safari iOS 5 – 7 Chrome Android No WebView Android No Samsung Internet 4.0 – 5.0 Opera Android 11 – 14

Returns *sharedWorker*'s [MessagePort](#) object which can be used to communicate with the global environment.

The **port** attribute must return the value it was assigned by the object's constructor. It represents the [MessagePort](#) for communicating with the shared worker.

A user agent has an associated *shared worker manager* which is the result of [starting a new parallel queue](#).

Each user agent has a single [shared worker manager](#) for simplicity. Implementations could use one per [origin](#); that would not be observably different and enables more concurrency.

When the *SharedWorker(scriptURL, options)* constructor is invoked:

1. Optionally, throw a "[SecurityError](#)" [DOMException](#) if the request violates a policy decision (e.g. if the user agent is configured to not allow the page to start shared workers).
2. If *options* is a [DOMString](#), set *options* to a new [WorkerOptions](#) dictionary whose **name** member is set to the value of *options* and whose other members are set to their default values.
3. Let *outside settings* be the [current settings object](#).
4. [Parse](#) *scriptURL* relative to *outside settings*.
5. If this fails, throw a "[SyntaxError](#)" [DOMException](#).
6. Otherwise, let *urlRecord* be the [resulting URL record](#).

Any [same-origin](#) URL (including [blob:](#) URLs) can be used. [data:](#) URLs can also be used, but they create a worker with an [opaque origin](#).

7. Let *worker* be a new [SharedWorker](#) object.
8. Let *outside port* be a [new MessagePort](#) in *outside settings*'s [Realm](#).
9. Assign *outside port* to the [port](#) attribute of *worker*.
10. Let *callerIsSecureContext* be true if *outside settings* is a [secure context](#); otherwise, false.
11. [Enqueue the following steps](#) to the [shared worker manager](#):

1. Let *worker global scope* be null.
2. If there exists a [SharedWorkerGlobalScope](#) object whose [closing](#) flag is false, [constructor origin](#) is [same origin](#) with *outside settings*'s [origin](#), [constructor url equals urlRecord](#), and [name](#) equals the value of *options*'s [name](#) member, then set *worker global scope* to that [SharedWorkerGlobalScope](#) object.

**[data:](#)** URLs create a worker with an [opaque origin](#). Both the [constructor origin](#) and [constructor url](#) are compared so the same **[data:](#)** URL can be used within an [origin](#) to get to the same [SharedWorkerGlobalScope](#) object, but cannot be used to bypass the [same origin](#) restriction.

3. If *worker global scope* is not null, but the user agent has been configured to disallow communication between the worker represented by the *worker global scope* and the [scripts](#) whose [settings object](#) is *outside settings*, then set *worker global scope* to null.

For example, a user agent could have a development mode that isolates a particular [top-level browsing context](#) from all other pages, and scripts in that development mode could be blocked from connecting to shared workers running in the normal browser mode.

4. If *worker global scope* is not null, then check if *worker global scope*'s [type](#) and [credentials](#) match the *options* values. If not, [queue a task](#) to [fire an event](#) named [error](#) and abort these steps.
5. If *worker global scope* is not null, then run these subsubsteps:
  1. Let *settings object* be the [relevant settings object](#) for *worker global scope*.
  2. Let *workerIsSecureContext* be true if *settings object* is a [secure context](#); otherwise, false.
  3. If *workerIsSecureContext* is not *callerIsSecureContext*, then [queue a task](#) to [fire an event](#) named [error](#) at *worker* and abort these steps.  
[\[SECURE-CONTEXTS\]](#)

4. Associate worker with worker *global scope*.
  5. Let *inside port* be a [new MessagePort](#) in *settings object's Realm*.
  6. [Entangle](#) *outside port* and *inside port*.
  7. [Queue a task](#), using the [DOM manipulation task source](#), to [fire an event](#) named [connect](#) at worker *global scope*, using [MessageEvent](#), with the [data](#) attribute initialized to the empty string, the [ports](#) attribute initialized to a new [frozen array](#) containing only *inside port*, and the [source](#) attribute initialized to *inside port*.
  8. [Append](#) the [relevant owner to add](#) given *outside settings* to worker *global scope's owner set*.
  6. Otherwise, [in parallel](#), [run a worker](#) given *worker*, *urlRecord*, *outside settings*, *outside port*, and *options*.
12. Return *worker*.

#### 10.2.7 Concurrent hardware capabilities

```
interface mixin NavigatorConcurrentHardware {
 readonly attribute unsigned long long hardwareConcurrency;
};
```

[\*\*self.navigator.hardwareConcurrency\*\*](#)

MDN

[Navigator/hardwareConcurrency](#)

Firefox 48+ Safari 10.1–11 Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) 15+ Internet Explorer No

Firefox Android 48+ Safari iOS 10.3–11 Chrome Android 37+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

[Navigator/hardwareConcurrency](#)

Firefox 48+ Safari 10.1–11 Chrome 37+

Opera 24+ Edge 79+

Edge (Legacy) 15+ Internet Explorer No

Firefox Android 48+ Safari iOS 10.3–11 Chrome Android 37+ WebView Android 37+ Samsung Internet 3.0+ Opera Android 24+

Returns the number of logical processors potentially available to the user agent.

(This  
is a  
tracking  
vector.)

The `navigator.hardwareConcurrency` attribute's getter must return a number between 1 and the number of logical processors potentially available to the user agent. If this cannot be determined, the getter must return 1.

User agents should err toward exposing the number of logical processors available, using lower values only in cases where there are user-agent specific limits in place (such as a limitation on the number of `workers` that can be created) or when the user agent desires to limit fingerprinting possibilities.

## 10.3 APIs available to workers

### 10.3.1 Importing scripts and libraries

The `importScripts(...urls)` method steps are to [import scripts into worker global scope](#) given [this](#) and `urls`.

To [import scripts into worker global scope](#), given a [WorkerGlobalScope](#) object `worker global scope` and a `sequence<DOMString>` `urls`, run these steps. The algorithm may optionally be customized by supplying custom [perform the fetch](#) hooks, which if provided will be used when invoking [fetch a classic worker-imported script](#).

1. If `worker global scope`'s `type` is "module", throw a [TypeError](#) exception.
2. Let `settings object` be the [current settings object](#).
3. If `urls` is empty, return.
4. Parse each value in `urls` relative to `settings object`. If any fail, throw a ["SyntaxError"](#) [DOMException](#).
5. For each `url` in the [resulting URL records](#), run these substeps:
  1. [Fetch a classic worker-imported script](#) given `url` and `settings object`, passing along any custom [perform the fetch](#) steps provided. If this succeeds, let `script` be the result. Otherwise, rethrow the exception.
  2. [Run the classic script](#) `script`, with the rethrow errors argument set to true.

`script` will run until it either returns, fails to parse, fails to catch an exception, or gets [prematurely aborted](#) by the [terminate a worker](#) algorithm defined above.

If an exception was thrown or if the script was [prematurely aborted](#), then abort all these steps, letting the exception or aborting continue to be processed by the calling [script](#).

Service Workers is an example of a specification that runs this algorithm with its own options for the [perform the fetch](#) hook. [SW]

### 10.3.2 The [WorkerNavigator](#) interface

✓MDN

#### [WorkerNavigator](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

Opera Yes Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android Yes

The `navigator` attribute of the [WorkerGlobalScope](#) interface must return an instance of the [WorkerNavigator](#) interface, which represents the identity and state of the user agent (the client):

```
[Exposed=Worker]
interface WorkerNavigator {};
WorkerNavigator includes NavigatorID;
WorkerNavigator includes NavigatorLanguage;
WorkerNavigator includes NavigatorOnLine;
WorkerNavigator includes NavigatorConcurrentHardware;
```

### 10.3.3 The [WorkerLocation](#) interface

✓MDN

#### [WorkerLocation](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 3+

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 10+

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

✓MDN

#### [WorkerLocation/toString](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera15+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android14+

```
[Exposed=Worker]
interface WorkerLocation {
 stringifier readonly attribute USVString href;
 readonly attribute USVString origin;
 readonly attribute USVString protocol;
 readonly attribute USVString host;
 readonly attribute USVString hostname;
 readonly attribute USVString port;
 readonly attribute USVString pathname;
 readonly attribute USVString search;
 readonly attribute USVString hash;
};
```

A [WorkerLocation](#) object has an associated [WorkerGlobalScope](#) object (a [WorkerGlobalScope](#) object).



[WorkerLocation\(href\)](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android12.1+

The `href` getter steps are to return `this`'s [WorkerGlobalScope](#) object's `url`, [serialized](#).



[WorkerLocation\(origin\)](#)

Support in all current engines.

Firefox29+Safari10+Chrome38+

---

Opera25+Edge79+

---

Edge (Legacy)14+Internet ExplorerNo

---

Firefox Android29+Safari iOS10+Chrome Android38+WebView Android38+Samsung Internet3.0+Opera Android25+

The *origin* getter steps are to return the [serialization](#) of [`this`'s `WorkerGlobalScope` object's `url`'s `origin`](#).



## [WorkerLocation/protocol](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

The *protocol* getter steps are to return [`this`'s `WorkerGlobalScope` object's `url`'s `scheme`](#), followed by ":".



## [WorkerLocation/host](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

The *host* getter steps are:

1. Let `url` be [`this`'s `WorkerGlobalScope` object's `url`](#).
2. If `url`'s `host` is null, return the empty string.
3. If `url`'s `port` is null, return `url`'s `host`, [serialized](#).
4. Return `url`'s `host`, [serialized](#), followed by ":" and `url`'s `port`, [serialized](#).



## [WorkerLocation/hostname](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 3+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The *hostname* getter steps are:

1. Let *host* be *this*'s [WorkerGlobalScope](#) object's [url](#)'s [host](#).
2. If *host* is null, return the empty string.
3. Return *host*, [serialized](#).



## [WorkerLocation/port](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 3+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 10+

---

Firefox Android 4+ Safari iOS 5+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The *port* getter steps are:

1. Let *port* be *this*'s [WorkerGlobalScope](#) object's [url](#)'s [port](#).
2. If *port* is null, return the empty string.
3. Return *port*, [serialized](#).



## [WorkerLocation pathname](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 3+

---

Opera 12.1+ Edge 79+

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

The ***pathname*** getter steps are to return the result of [URL path serializing this's WorkerGlobalScope object's url](#).



## [WorkerLocation/search](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

The ***search*** getter steps are:

1. Let *query* be [this's WorkerGlobalScope object's url's query](#).
2. If *query* is either null or the empty string, return the empty string.
3. Return "?", followed by *query*.



## [WorkerLocation/hash](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome3+

---

Opera12.1+Edge79+

---

Edge (Legacy)12+Internet Explorer10+

---

Firefox Android4+Safari iOS5+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android12.1+

The ***hash*** getter steps are:

1. Let *fragment* be [this's WorkerGlobalScope object's url's fragment](#).
2. If *fragment* is either null or the empty string, return the empty string.
3. Return "#", followed by *fragment*.

# 11 Worklets

## 11.1 Introduction

*This section is non-normative.*

Worklets are a piece of specification infrastructure which can be used for running scripts independent of the main JavaScript execution environment, while not requiring any particular implementation model.

The worklet infrastructure specified here cannot be used directly by web developers. Instead, other specifications build upon it to create directly-usable worklet types, specialized for running in particular parts of the browser implementation pipeline.

### 11.1.1 Motivations

*This section is non-normative.*

Allowing extension points to rendering, or other sensitive parts of the implementation pipeline such as audio output, is difficult. If extension points were done with full access to the APIs available on [Window](#), engines would need to abandon previously-held assumptions for what could happen in the middle of those phases. For example, during the layout phase, rendering engines assume that no DOM will be modified.

Additionally, defining extension points in the [Window](#) environment would restrict user agents to performing work in the same thread as the [Window](#) object. (Unless implementations added complex, high-overhead infrastructure to allow thread-safe APIs, as well as thread-joining guarantees.)

Worklets are designed to allow extension points, while keeping guarantees that user agents currently rely on. This is done through new global environments, based on subclasses of [WorkletGlobalScope](#).

Worklets are similar to web workers. However, they:

- Are thread-agnostic. That is, they are not designed to run on a dedicated separate thread, like each worker is. Implementations can run worklets wherever they choose (including on the main thread).
- Are able to have multiple duplicate instances of the global scope created, for the purpose of parallelism.
- Do not use an event-based API. Instead, classes are registered on the global scope, whose methods are invoked by the user agent.
- Have a reduced API surface on the global scope.

- Have a lifetime for their [global object](#) which is defined by other specifications, often in an [implementation-defined](#) manner.

As worklets have relatively high overhead, they are best used sparingly. Due to this, a given [WorkletGlobalScope](#) is expected to be shared between multiple separate scripts. (This is similar to how a single [Window](#) is shared between multiple separate scripts.)

Worklets are a general technology that serve different use cases. Some worklets, such as those defined in *CSS Painting API*, provide extension points intended for stateless, idempotent, and short-running computations, which have special considerations as described in the next couple of sections. Others, such as those defined in *Web Audio API*, are used for stateful, long-running operations. [\[CSSPAINT\]](#) [\[WEBAUDIO\]](#)

### 11.1.2 Code idempotence

Some specifications which use worklets are intended to allow user agents to parallelize work over multiple threads, or to move work between threads as required. In these specifications, user agents might invoke methods on a web-developer-provided class in an [implementation-defined](#) order.

As a result of this, to prevent interoperability issues, authors who register classes on such [WorkletGlobalScopes](#) should make their code idempotent. That is, a method or set of methods on the class should produce the same output given a particular input.

This specification uses the following techniques in order to encourage authors to write code in an idempotent way:

- No reference to the global object is available (i.e., there is no counterpart to [self](#) on [WorkletGlobalScope](#)).

Although this was the intention when worklets were first specified, the introduction of [globalThis](#) has made it no longer true. See [issue #6059](#) for more discussion.

- Code is loaded as a [module script](#), which results in the code being executed in strict mode and with no shared [this](#) referencing the global proxy.

Together, these restrictions help prevent two different scripts from sharing state using properties of the [global object](#).

Additionally, specifications which use worklets and intend to allow [implementation-defined](#) behavior must obey the following:

- They must require user agents to always have at least two [WorkletGlobalScope](#) instances per [Worklet](#), and randomly assign a method or set of methods on a class to a particular [WorkletGlobalScope](#) instance. These specifications may provide an opt-out under memory constraints.

- These specifications must allow user agents to create and destroy instances of their [WorkletGlobalScope](#) subclasses at any time.

### 11.1.3 Speculative evaluation

Some specifications which use worklets can invoke methods on a web-developer-provided class based on the state of the user agent. To increase concurrency between threads, a user agent may invoke a method speculatively, based on potential future states.

In these specifications, user agents might invoke such methods at any time, and with any arguments, not just ones corresponding to the current state of the user agent. The results of such speculative evaluations are not displayed immediately, but can be cached for use if the user agent state matches the speculated state. This can increase the concurrency between the user agent and worklet threads.

As a result of this, to prevent interoperability risks between user agents, authors who register classes on such [WorkletGlobalScope](#)s should make their code stateless. That is, the only effect of invoking a method should be its result, and not any side effects such as updating mutable state.

The same techniques which encourage [code idempotence](#) also encourage authors to write stateless code.

## 11.2 Examples

*This section is non-normative.*

For these examples, we'll use a fake worklet. The [Window](#) object provides two [Worklet](#) instances, which each run code in their own collection of [FakeWorkletGlobalScope](#)s:

```
partial interface Window {
 [SameObject, SecureContext] readonly attribute Worklet fakeWorklet1;
 [SameObject, SecureContext] readonly attribute Worklet fakeWorklet2;
};
```

Each [Window](#) has two [Worklet](#) instances, *fake worklet 1* and *fake worklet 2*. Both of these have their [worklet global scope type](#) set to [FakeWorkletGlobalScope](#), and their [worklet destination type](#) set to "[fakeworklet](#)". User agents should create at least two [FakeWorkletGlobalScope](#) instances per worklet.

"[fakeworklet](#)" is not actually a valid [destination](#) per [Fetch](#). But this illustrates how real worklets would generally have their own worklet-type-specific destination. [\[FETCH\]](#)

The *fakeWorklet1* getter steps are to return [this](#)'s [fake worklet 1](#).

The *fakeWorklet2* getter steps are to return [this](#)'s [fake worklet 2](#).

```
[Global=(Worklet,FakeWorklet),
 Exposed=FakeWorklet,
 SecureContext]
interface FakeWorkletGlobalScope : WorkletGlobalScope {
 undefined registerFake(DOMString type, Function classConstructor);
};
```

Each [FakeWorkletGlobalScope](#) has a *registered class constructors map*, which is an [ordered map](#), initially empty.

The [registerFake\(type, classConstructor\)](#) method steps are to set [this's registered class constructors map](#)[*type*] to *classConstructor*.

### 11.2.1 Loading scripts

*This section is non-normative.*

To load scripts into [fake worklet 1](#), a web developer would write:

```
window.fakeWorklet1.addModule('script1.mjs');
window.fakeWorklet1.addModule('script2.mjs');
```

Note that which script finishes fetching and runs first is dependent on network timing: it could be either `script1.mjs` or `script2.mjs`. This generally won't matter for well-written scripts intended to be loaded in worklets, if they follow the suggestions about preparing for [speculative evaluation](#).

If a web developer wants to perform a task only after the scripts have successfully run and loaded into some worklets, they could write:

```
Promise.all([
 window.fakeWorklet1.addModule('script1.mjs'),
 window.fakeWorklet2.addModule('script2.mjs')
]).then(() => {
 // Do something which relies on those scripts being loaded.
});
```

---

Another important point about script-loading is that loaded scripts can be run in multiple [WorkletGlobalScopes](#) per [Worklet](#), as discussed in the section on [code idempotence](#). In particular, the specification above for [fake worklet 1](#) and [fake worklet 2](#) require this. So, consider a scenario such as the following:

```
// script.mjs
console.log("Hello from a FakeWorkletGlobalScope!");

// app.mjs
```

```
window.fakeWorklet1.addModule("script.mjs");
```

This could result in output such as the following from a user agent's console:

```
[fakeWorklet1#1] Hello from a FakeWorkletGlobalScope!
[fakeWorklet1#4] Hello from a FakeWorkletGlobalScope!
[fakeWorklet1#2] Hello from a FakeWorkletGlobalScope!
[fakeWorklet1#3] Hello from a FakeWorkletGlobalScope!
```

If the user agent at some point decided to kill and restart the third instance of [FakeWorkletGlobalScope](#), the console would again print [fakeWorklet1#3] Hello from a FakeWorkletGlobalScope! when this occurs.

### 11.2.2 Registering a class and invoking its methods

*This section is non-normative.*

Let's say that one of the intended usages of our fake worklet by web developers is to allow them to customize the highly-complex process of boolean negation. They might register their customization as follows:

```
// script.mjs
registerFake('negation-processor', class {
 process(arg) {
 return !arg;
 }
});

// app.mjs
window.fakeWorklet1.addModule("script.mjs");
```

To make use of such registered classes, the specification for fake worklets could define a *find the opposite of true* algorithm, given a [Worklet](#) worklet:

1. Optionally, [create a worklet global scope](#) for *worklet*.
2. Let *workletGlobalScope* be one of *worklet*'s [global scopes](#), chosen in an [implementation-defined](#) manner.
3. Let *classConstructor* be *workletGlobalScope*'s [registered class constructors map](#)["negation-processor"].
4. Let *classInstance* be the result of [constructing](#) *classConstructor*, with no arguments.
5. Let *function* be [Get](#)(*classInstance*, "process"). Rethrow any exceptions.
6. Let *callback* be the result of [converting](#) *function* to a Web IDL [Function](#) instance.

7. Return the result of [invoking](#) `callback` with the arguments « true » and with `classInstance` as the [callback this value](#).

Another, perhaps better, specification architecture would be to extract the "process" property and convert it into a [Function](#) at registration time, as part of the [registerFake\(\)](#) method steps.

## 11.3 Infrastructure

### 11.3.1 The global scope

Subclasses of [WorkletGlobalScope](#) are used to create [global objects](#) wherein code loaded into a particular [Worklet](#) can execute.

```
[Exposed=Worklet, SecureContext]
interface WorkletGlobalScope {};
```

Other specifications are intended to subclass [WorkletGlobalScope](#), adding APIs to register a class, as well as other APIs specific for their worklet type.

Each [WorkletGlobalScope](#) has an associated *module map*. It is a [module map](#), initially empty.

#### 11.3.1.1 Agents and event loops

*This section is non-normative.*

Each [WorkletGlobalScope](#) is contained in its own [worklet agent](#), which has its corresponding [event loop](#). However, in practice, implementation of these agents and event loops is expected to be different from most others.

A [worklet agent](#) exists for each [WorkletGlobalScope](#) since, in theory, an implementation could use a separate thread for each [WorkletGlobalScope](#) instance, and allowing this level of parallelism is best done using agents. However, because their `[[CanBlock]]` value is false, there is no requirement that agents and threads are one-to-one. This allows implementations the freedom to execute scripts loaded into a worklet on any thread, including one running code from other agents with `[[CanBlock]]` of false, such as the thread of a [similar-origin window agent](#) ("the main thread"). Contrast this with [dedicated worker agents](#), whose true value for `[[CanBlock]]` effectively requires them to get a dedicated operating system thread.

Worklet [event loops](#) are also somewhat special. They are only used for [tasks](#) associated with [addModule\(\)](#), tasks wherein the user agent invokes author-defined methods, and [microtasks](#). Thus, even though the [event loop processing model](#) specifies that all event loops run continuously, implementations can achieve observably-equivalent results using a simpler strategy, which just [invokes](#) author-provided methods and then relies on that process to [perform a microtask checkpoint](#).

### 11.3.1.2 Creation and termination

To create a worklet global scope for a [Worklet](#) worklet:

1. Let *outsideSettings* be *worklet*'s [relevant settings object](#).
2. Let *agent* be the result of [obtaining a worklet agent](#) given *outsideSettings*. Run the rest of these steps in that agent.
3. Let *realmExecutionContext* be the result of [creating a new JavaScript realm](#) given *agent* and the following customizations:
  - For the global object, create a new object of the type given by *worklet*'s [worklet global scope type](#).
4. Let *workletGlobalScope* be the [global object](#) of *realmExecutionContext*'s Realm component.
5. Let *insideSettings* be the result of [setting up a worklet environment settings object](#) given *realmExecutionContext* and *outsideSettings*.
6. [For each](#) *moduleURL* of *worklet*'s [added modules list](#):
  1. [Fetch a worklet script graph](#) given *moduleURL*, *insideSettings*, *worklet*'s [worklet destination type](#), what credentials mode?, *insideSettings*, and *worklet*'s [module responses map](#). Wait until the algorithm asynchronously completes with *script*.

This will not actually perform a network request, as it will just reuse [responses](#) from *worklet*'s [module responses map](#). The main purpose of this step is to create a new *workletGlobalScope*-specific [module script](#) from the [response](#).
  2. Assert: *script* is not null, since the fetch succeeded and the source text was successfully parsed when *worklet*'s [module responses map](#) was initially populated with *moduleURL*.
  3. [Run a module script](#) given *script*.
7. [Append](#) *workletGlobalScope* to *outsideSettings*'s [global object](#)'s [associated Document](#)'s [worklet global scopes](#).
8. [Append](#) *workletGlobalScope* to *worklet*'s [global scopes](#).
9. Run the [responsible event loop](#) specified by *insideSettings*.

To terminate a worklet global scope given a [WorkletGlobalScope](#) *workletGlobalScope*:

1. Let *eventLoop* be *workletGlobalScope*'s [relevant agent](#)'s [event loop](#).

2. If there are any [tasks](#) queued in *eventLoop*'s [task queues](#), discard them without processing them.
3. Wait for *eventLoop* to complete the [currently running task](#).
4. If the previous step doesn't complete within an [implementation-defined](#) period of time, then [abort the script](#) currently running in the worklet.
5. Destroy *eventLoop*.
6. [Remove](#) *workletGlobalScope* from the [global scopes](#) of the [Worklet](#) whose [global scopes](#) contains *workletGlobalScope*.
7. [Remove](#) *workletGlobalScope* from the [worklet global scopes](#) of the [Document](#) whose [worklet global scopes](#) contains *workletGlobalScope*.

#### 11.3.1.3 Script settings for worklets

To set up a worklet environment settings object, given a [JavaScript execution context](#) *executionContext* and an [environment settings object](#) *outsideSettings*:

1. Let *origin* be a unique [opaque origin](#).
2. Let *inheritedAPIBaseURL* be *outsideSettings*'s [API base URL](#).
3. Let *inheritedPolicyContainer* be a [clone](#) of *outsideSettings*'s [policy container](#).
4. Let *realm* be the value of *executionContext*'s Realm component.
5. Let *workletGlobalScope* be *realm*'s [global object](#).
6. Let *settingsObject* be a new [environment settings object](#) whose algorithms are defined as follows:

##### The [realm execution context](#)

Return *executionContext*.

##### The [module map](#)

Return *workletGlobalScope*'s [module map](#).

##### The [responsible document](#)

Not applicable (the [responsible event loop](#) is not a [window event loop](#)).

## The [API URL character encoding](#)

Return [UTF-8](#).

## The [API base URL](#)

Return *inheritedAPIBaseURL*.

Unlike workers or other globals derived from a single resource, worklets have no primary resource; instead, multiple scripts, each with their own URL, are loaded into the global scope via [worklet.addModule\(\)](#). So this [API base URL](#) is rather unlike that of other globals. However, so far this doesn't matter, as no APIs available to worklet code make use of the [API base URL](#).

## The [origin](#)

Return *origin*.

## The [policy container](#)

Return *inheritedPolicyContainer*.

## The [cross-origin isolated capability](#)

Return TODO.

7. Set *settingsObject*'s [id](#) to a new unique opaque string, [creation URL](#) to *inheritedAPIBaseURL*, [top-level creation URL](#) to null, [top-level origin](#) to *outsideSettings*'s [top-level origin](#), [target browsing context](#) to null, and [active service worker](#) to null.
8. Set *realm*'s [\[\[HostDefined\]\]](#) field to *settingsObject*.
9. Return *settingsObject*.

### 11.3.2 The [Worklet](#) class



#### [Worklet](#)

Support in all current engines.

Firefox 76+ Safari 14.1+ Chrome 65+

---

Opera 52+ Edge 79+

---

Edge (Legacy) No Internet Explorer No

---

Firefox Android 79+ Safari iOS 14.5+ Chrome Android 65+ WebView Android 65+ Samsung

Internet9.0+Opera Android47+

The [Worklet](#) class provides the capability to add module scripts into its associated [WorkletGlobalScope](#)s. The user agent can then create classes registered on the [WorkletGlobalScope](#)s and invoke their methods.

```
[Exposed=Window, SecureContext]
interface Worklet {
 [NewObject] Promise<undefined> addModule(USVString moduleURL, optional WorkletOptions credentials);
}

dictionary WorkletOptions {
 RequestCredentials credentials = "same-origin";
};
```

Specifications that create [Worklet](#) instances must specify the following for a given instance:

- its *worklet global scope type*, which must be a Web IDL type that [inherits](#) from [WorkletGlobalScope](#); and
- its *worklet destination type*, which must be a [destination](#), and is used when fetching scripts.

`await worklet.addModule(moduleURL[, { credentials }])`

MDN

[Worklet/addModule](#)

Firefox76+SafariNoChrome65+

Opera52+Edge79+

Edge (Legacy)NoInternet ExplorerNo

Firefox Android79+Safari iOSNoChrome Android65+WebView Android65+Samsung Internet9.0+Opera Android47+

Loads and executes the [module script](#) given by *moduleURL* into all of *worklet's global scopes*. It can also create additional global scopes as part of this process, depending on the worklet type. The returned promise will fulfill once the script has been successfully loaded and run in all global scopes.

The [credentials](#) option can be set to a [credentials mode](#) to modify the script-fetching process. It defaults to "[same-origin](#)".

Any failures in [fetching](#) the script or its dependencies will cause the returned promise to be rejected with an "[AbortError](#)" [DOMException](#). Any errors in parsing the script or its dependencies will cause the returned promise to be rejected with the exception generated during parsing.

A [Worklet](#) has a [list](#) of *global scopes*, which contains instances of the [Worklet](#)'s [worklet global scope type](#). It is initially empty.

A [Worklet](#) has an *added modules list*, which is a [list](#) of [URLs](#), initially empty. Access to this list should be thread-safe.

A [Worklet](#) has a *module responses map*, which is an [ordered map](#) from [URLs](#) to [responses](#), initially empty. Access to this map should be thread-safe.

The [added modules list](#) and [module responses map](#) exist to ensure that [WorkletGlobalScope](#)s created at different times get equivalent [module scripts](#) run in them, based on the same source text. This allows the creation of additional [WorkletGlobalScope](#)s to be transparent to the author.

In practice, user agents are not expected to implement these data structures, and the algorithms that consult them, using thread-safe programming techniques. Instead, when [addModule\(\)](#) is called, user agents can fetch the module graph on the main thread, and send the fetched source text (i.e., the important data contained in the [module responses map](#)) to each thread which has a [WorkletGlobalScope](#).

Then, when a user agent [creates](#) a new [WorkletGlobalScope](#) for a given [Worklet](#), it can simply send the map of fetched source text and the list of entry points from the main thread to the thread containing the new [WorkletGlobalScope](#).

The [addModule\(moduleURL, options\)](#) method steps are:

1. Let *outsideSettings* be the [relevant settings object](#) of [this](#).
2. [Parse](#) *moduleURL* relative to *outsideSettings*.
3. If this fails, then return a promise rejected with a ["SyntaxError" DOMException](#).
4. Let *moduleURLRecord* be the [resulting URL record](#).
5. Let *promise* be a new promise.
6. Run the following steps [in parallel](#):
  1. If [this](#)'s [global scopes](#) [is empty](#), then:
    1. [Create a worklet global scope](#) given [this](#).
    2. Optionally, [create](#) additional global scope instances given [this](#), depending on the specific worklet in question and its specification.
    3. Wait for all steps of the [creation](#) process(es) — including those taking place within the [worklet agents](#) — to complete, before moving on.

2. Let *pendingTasks* be *this*'s [global scopes](#)'s [size](#).
3. Let *addedSuccessfully* be false.
4. For each *workletGlobalScope* of *this*'s [global scopes](#), queue a global task on the [networking task source](#) given *workletGlobalScope* to perform the following steps:
  1. Fetch a worklet script graph given *moduleURLRecord*, *outsideSettings*, *this*'s [worklet destination type](#), *options*[["credentials"](#)], *workletGlobalScope*'s [relevant settings object](#), and *this*'s [module responses map](#). Wait until the algorithm asynchronously completes with *script*.
 

Only the first of these fetches will actually perform a network request; the ones for other [WorkletGlobalScope](#)s will reuse reuse [responses](#) from *this*'s [module responses map](#).
  2. If *script* is null, then:
    1. Queue a global task on the [networking task source](#) given *this*'s [relevant global object](#) to perform the following steps:
      1. If *pendingTasks* is not -1, then:
        1. Set *pendingTasks* to -1.
        2. Reject *promise* with an ["AbortError"](#) [DOMException](#).
      2. Abort these steps.
    3. If *script*'s [error to rethrow](#) is not null, then:
      1. Queue a global task on the [networking task source](#) given *this*'s [relevant global object](#) to perform the following steps:
        1. If *pendingTasks* is not -1, then:
          1. Set *pendingTasks* to -1.
          2. Reject *promise* with *script*'s [error to rethrow](#).
        2. Abort these steps.
    4. If *addedSuccessfully* is false, then:
      1. Append *moduleURLRecord* to *this*'s [added modules list](#).

2. Set *addedSuccessfully* to true.
5. [Run a module script](#) given *script*.
6. [Queue a global task](#) on the [networking task source](#) given [this's relevant global object](#) to perform the following steps:
  1. If *pendingTasks* is not  $-1$ , then:
    1. Set *pendingTasks* to *pendingTasks*  $- 1$ .
    2. If *pendingTasks* is 0, then resolve *promise*.
7. Return *promise*.

### 11.3.3 The worklet's lifetime

The lifetime of a [Worklet](#) has no special considerations; it is tied to the object it belongs to, such as the [Window](#).

Each [Document](#) has a *worklet global scopes*, which is a [set](#) of [WorkletGlobalScopes](#), initially empty.

The lifetime of a [WorkletGlobalScope](#) is, at a minimum, tied to the [Document](#) whose *worklet global scopes* contain it. In particular, [discarding](#) the [Document](#) will [terminate](#) the corresponding [WorkletGlobalScope](#) and allow it to be garbage-collected.

Additionally, user agents may, at any time, [terminate](#) a given [WorkletGlobalScope](#), unless the specification defining the corresponding worklet type says otherwise. For example, they might terminate them if the [worklet agent's event loop](#) has no [tasks](#) queued, or if the user agent has no pending operations planning to make use of the worklet, or if the user agent detects abnormal operations such as infinite loops or callbacks exceeding imposed time limits.

Finally, specifications for specific worklet types can give more specific details on when to [create WorkletGlobalScopes](#) for a given worklet type. For example, they might create them during specific processes that call upon worklet code, as in the [example](#).

## 12 Web storage



### [Web\\_Storage\\_API](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

---

Opera10.5+Edge79+

---

Edge (Legacy)12+Internet Explorer8+

---

Firefox Android6+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

## [Web\\_Storage\\_API/Using\\_the\\_Web\\_Storage\\_API](#)

### 12.1 Introduction

*This section is non-normative.*

This specification introduces two related mechanisms, similar to HTTP session cookies, for storing name-value pairs on the client side. [\[COOKIES\]](#)

The first is designed for scenarios where the user is carrying out a single transaction, but could be carrying out multiple transactions in different windows at the same time.

Cookies don't really handle this case well. For example, a user could be buying plane tickets in two different windows, using the same site. If the site used cookies to keep track of which ticket the user was buying, then as the user clicked from page to page in both windows, the ticket currently being purchased would "leak" from one window to the other, potentially causing the user to buy two tickets for the same flight without noticing.

To address this, this specification introduces the [sessionStorage](#) getter. Sites can add data to the session storage, and it will be accessible to any page from the same site opened in that window.

For example, a page could have a checkbox that the user ticks to indicate that they want insurance:

```
<label>
 <input type="checkbox" onchange="sessionStorage.insurance = checked ? 'true'
 I want insurance on this trip.
</label>
```

A later page could then check, from script, whether the user had checked the checkbox or not:

```
if (sessionStorage.insurance) { . . . }
```

If the user had multiple windows opened on the site, each one would have its own individual copy of the session storage object.

The second storage mechanism is designed for storage that spans multiple windows, and lasts beyond the current session. In particular, web applications might wish to store megabytes of user data, such as entire user-authored documents or a user's mailbox, on the client side for performance reasons.

Again, cookies do not handle this case well, because they are transmitted with every request.

The [localStorage](#) getter is used to access a page's local storage area.

The site at example.com can display a count of how many times the user has loaded its page by putting the following at the bottom of its page:

```
<p>
 You have viewed this page
 an untold number of
 time(s).
</p>
<script>
 if (!localStorage.pageLoadCount)
 localStorage.pageLoadCount = 0;
 localStorage.pageLoadCount = parseInt(localStorage.pageLoadCount) + 1;
 document.getElementById('count').textContent = localStorage.pageLoadCount;
</script>
```

Each site has its own separate storage area.

The [localStorage](#) getter provides access to shared state. This specification does not define the interaction with other browsing contexts in a multiprocess user agent, and authors are encouraged to assume that there is no locking mechanism. A site could, for instance, try to read the value of a key, increment its value, then write it back out, using the new value as a unique identifier for the session; if the site does this twice in two different browser windows at the same time, it might end up using the same "unique" identifier for both sessions, with potentially disastrous effects.

## 12.2 The API



### [Storage](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera 10.5+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 8+

---

Firefox Android 6+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

#### 12.2.1 The [Storage](#) interface

[Exposed=Window]

```
interface Storage {
 readonly attribute unsigned long length;
 DOMString? key(unsigned long index);
 getter DOMString? getItem(DOMString key);
 setter undefined setItem(DOMString key, DOMString value);
 deleter undefined removeItem(DOMString key);
 undefined clear();
};
```

## **storage.length**

✓MDN

### Storage/length

Support in all current engines.

---

Firefox3.5+Safari4+Chrome4+

---

Opera10.5+Edge79+

---

Edge (Legacy)12+Internet Explorer8+

---

Firefox Android6+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

Returns the number of key/value pairs.

## **storage.key (n)**

✓MDN

### Storage/key

Support in all current engines.

---

Firefox3.5+Safari4+Chrome4+

---

Opera10.5+Edge79+

---

Edge (Legacy)12+Internet Explorer8+

---

Firefox Android6+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung Internet1.0+Opera Android11+

Returns the name of the *n*th key, or null if *n* is greater than or equal to the number of key/value pairs.

## **value = storage.getItem (key)**

✓MDN

### Storage/getItem

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

---

Opera10.5+Edge79+

---

Edge (Legacy)12+Internet Explorer8+

---

Firefox Android6+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android11+

**value = storage[key]**

Returns the current value associated with the given key, or null if the given key does not exist.

**storage.setItem (key, value)**

✓MDN

[Storage.setItem](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

---

Opera10.5+Edge79+

---

Edge (Legacy)12+Internet Explorer8+

---

Firefox Android6+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android11+

**storage[key] = value**

Sets the value of the pair identified by key to value, creating a new key/value pair if none existed for key previously.

Throws a ["QuotaExceededError"](#) [DOMException](#) exception if the new value couldn't be set. (Setting could fail if, e.g., the user has disabled storage for the site, or if the quota has been exceeded.)

Dispatches a [storage](#) event on [Window](#) objects holding an equivalent [Storage](#) object.

## `storage.removeItem (key)`

✓MDN

### [Storage/removeItem](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

Opera10.5+Edge79+

Edge (Legacy)12+Internet Explorer8+

Firefox Android6+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android11+

**[delete storage\[key\]](#)**

Removes the key/value pair with the given *key*, if a key/value pair with the given *key* exists.

Dispatches a [storage](#) event on [Window](#) objects holding an equivalent [Storage](#) object.

## `storage.clear()`

✓MDN

### [Storage/clear](#)

Support in all current engines.

Firefox3.5+Safari4+Chrome4+

Opera10.5+Edge79+

Edge (Legacy)12+Internet Explorer8+

Firefox Android6+Safari iOS3.2+Chrome Android18+WebView Android37+Samsung

Internet1.0+Opera Android11+

Removes all key/value pairs, if there are any.

Dispatches a [storage](#) event on [Window](#) objects holding an equivalent [Storage](#) object.

A [Storage](#) object has an associated:

*map*

A [storage proxy map](#).

*type*

"`local`" or "`session`".

To reorder a [Storage](#) object *storage*, reorder *storage*'s [map](#)'s [entries](#) in an [implementation-defined](#) manner.

Unfortunate as it is, iteration order is not defined and can change upon most mutations.

To broadcast a **Storage** object storage, given a *key*, *oldValue*, and *newValue*, run these steps:

1. Let *url* be *storage*'s [relevant global object](#)'s [associated Document](#)'s [URL](#).
2. Let *remoteStorages* be all **Storage** objects excluding *storage* whose:
  - *type* is *storage*'s [type](#)
  - *relevant settings object*'s [origin](#) is [same origin](#) with *storage*'s [relevant settings object](#)'s [origin](#).

and, if *type* is "session", whose [relevant settings object](#)'s [browsing session](#) is *storage*'s [relevant settings object](#)'s [browsing session](#).

3. For each *remoteStorage* of *remoteStorages*: [queue a global task](#) on the [DOM manipulation task source](#) given *remoteStorage*'s [relevant global object](#) to [fire an event](#) named [storage](#) at *remoteStorage*'s [relevant global object](#), using **StorageEvent**, with [key](#) initialized to *key*, [oldValue](#) initialized to *oldValue*, [newValue](#) initialized to *newValue*, [url](#) initialized to *url*, and [storageArea](#) initialized to *remoteStorage*.

The [Document](#) object associated with the resulting [task](#) is not necessarily [fully active](#), but events fired on such objects are ignored by the [event loop](#) until the [Document](#) becomes [fully active](#) again.

---

The *length* getter steps are to return [this](#)'s [map](#)'s [size](#).

The *key(index)* method steps are:

1. If *index* is greater than or equal to [this](#)'s [map](#)'s [size](#), then return null.
2. Let *keys* be the result of running [get the keys](#) on [this](#)'s [map](#).
3. Return *keys*[*index*].

The [supported property names](#) on a **Storage** object storage are the result of running [get the keys](#) on *storage*'s [map](#).

The *getItem(key)* method steps are:

1. If [this](#)'s [map](#)[*key*] does not [exist](#), then return null.
2. Return [this](#)'s [map](#)[*key*].

The *setItem(key, value)* method are:

1. Let *oldValue* be null.
2. Let *reorder* be true.
3. If *this*'s *map*[*key*] exists:
  1. Set *oldValue* to *this*'s *map*[*key*].
  2. If *oldValue* is *value*, then return.
  3. Set *reorder* to false.
4. If *value* cannot be stored, then throw a ["QuotaExceededError" DOMException](#) exception.
5. Set *this*'s *map*[*key*] to *value*.
6. If *reorder* is true, then [reorder this](#).
7. [Broadcast this](#) with *key*, *oldValue*, and *value*.

The *removeItem(key)* method steps are:

1. If *this*'s *map*[*key*] does not exist, then return null.
2. Set *oldValue* to *this*'s *map*[*key*].
3. [Remove this](#)'s *map*[*key*].
4. [Reorder this](#).
5. [Broadcast this](#) with *key*, *oldValue*, and null.

The *clear()* method steps are:

1. [Clear this](#)'s *map*.
2. [Broadcast this](#) with null, null, and null.

### 12.2.2 The [\*\*sessionStorage\*\*](#) getter

```
interface mixin WindowSessionStorage {
 readonly attribute Storage sessionStorage;
};

Window includes WindowSessionStorage;
```

**window.sessionStorage**

[Window/sessionStorage](#)

Support in all current engines.

Firefox 2+ Safari 4+ Chrome 5+

---

Opera 10.5+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 8+

---

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

Returns the [Storage](#) object associated with that *window*'s origin's session storage area.

Throws a ["SecurityError" DOMException](#) if the [Document](#)'s [origin](#) is an [opaque origin](#) or if the request violates a policy decision (e.g., if the user agent is configured to not allow the page to persist data).

A [Document](#) object has an associated *session storage holder*, which is null or a [Storage](#) object. It is initially null.

(This  
is a  
tracking  
vector.) The *sessionStorage* getter steps are:

1. If *this*'s associated [Document](#)'s [session storage holder](#) is non-null, then return *this*'s associated [Document](#)'s [session storage holder](#).
2. Let *map* be the result of running [obtain a session storage bottle map](#) with *this*'s [relevant settings object](#) and "sessionStorage".
3. If *map* is failure, then throw a ["SecurityError" DOMException](#).
4. Let *storage* be a new [Storage](#) object whose [map](#) is *map*.
5. Set *this*'s associated [Document](#)'s [session storage holder](#) to *storage*.
6. Return *storage*.

While [creating a new auxiliary browsing context](#), the session storage [is copied](#) over.

### 12.2.3 The [localStorage](#) getter

```
interface mixin WindowLocalStorage {
 readonly attribute Storage localStorage;
};
```

[Window](#) includes [WindowLocalStorage](#);

## [window.localStorage](#)

✓MDN

### [Window/localStorage](#)

Support in all current engines.

Firefox 3.5+ Safari 4+ Chrome 4+

---

Opera 10.5+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 8+

---

Firefox Android 4+ Safari iOS 3.2+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 11+

Returns the [Storage](#) object associated with `window`'s origin's local storage area.

Throws a "[SecurityError](#)" [DOMException](#) if the [Document](#)'s [origin](#) is an [opaque origin](#) or if the request violates a policy decision (e.g., if the user agent is configured to not allow the page to persist data).

A [Document](#) object has an associated *local storage holder*, which is null or a [Storage](#) object. It is initially null.

(This  
is a  
tracking  
vector.) The `localStorage` getter steps are:

1. If `this`'s associated [Document](#)'s [local storage holder](#) is non-null, then return `this`'s associated [Document](#)'s [local storage holder](#).
2. Let `map` be the result of running [obtain a local storage bottle map](#) with `this`'s [relevant settings object](#) and "`localStorage`".
3. If `map` is failure, then throw a "[SecurityError](#)" [DOMException](#).
4. Let `storage` be a new [Storage](#) object whose [map](#) is `map`.
5. Set `this`'s associated [Document](#)'s [local storage holder](#) to `storage`.
6. Return `storage`.

#### 12.2.4 The [StorageEvent](#) interface

✓MDN

## StorageEvent

Support in all current engines.

Firefox 13+ Safari 4+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android 14+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

[Exposed=Window]

```
interface StorageEvent : Event {
 constructor(DOMString type, optional StorageEventInit eventInitDict = {});

 readonly attribute DOMString? key;
 readonly attribute DOMString? oldValue;
 readonly attribute DOMString? newValue;
 readonly attribute USVString url;
 readonly attribute Storage? storageArea;

 undefined initStorageEvent(DOMString type, optional boolean bubbles = false);
};

dictionary StorageEventInit : EventInit {
 DOMString? key = null;
 DOMString? oldValue = null;
 DOMString? newValue = null;
 USVString url = "";
 Storage? storageArea = null;
};
```

### **event.key**

Returns the key of the storage item being changed.

### **event.oldValue**

Returns the old value of the key of the storage item whose value is being changed.

### **event.newValue**

Returns the new value of the key of the storage item whose value is being changed.

### **event.url**

Returns the [URL](#) of the document whose storage item changed.

## `event.storageArea`

Returns the [Storage](#) object that was affected.

The `key`, `oldValue`, `newValue`, `url`, and `storageArea` attributes must return the values they were initialized to.



### [StorageEvent/initStorageEvent](#)

Support in all current engines.

Firefox 13+ Safari 4+ Chrome 4+

---

Opera 12.1+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android 14+ Safari iOS 3+ Chrome Android 18+ WebView Android 37+ Samsung Internet 1.0+ Opera Android 12.1+

The `initStorageEvent(type, bubbles, cancelable, key, oldValue, newValue, url, storageArea)` method must initialize the event in a manner analogous to the similarly-named [initEvent\(\)](#) method. [\[DOM\]](#)

## 12.3 Privacy

### 12.3.1 User tracking

A third-party advertiser (or any entity capable of getting content distributed to multiple sites) could use a unique identifier stored in its local storage area to track a user across multiple sessions, building a profile of the user's interests to allow for highly targeted advertising. In conjunction with a site that is aware of the user's real identity (for example an e-commerce site that requires authenticated credentials), this could allow oppressive groups to target individuals with greater accuracy than in a world with purely anonymous web usage.

There are a number of techniques that can be used to mitigate the risk of user tracking:

#### Blocking third-party storage

User agents may restrict access to the [localStorage](#) objects to scripts originating at the domain of the [active document](#) of the [top-level browsing context](#), for instance denying access to the API for pages from other domains running in [iframes](#).

#### Epiring stored data

User agents may, possibly in a manner configured by the user, automatically delete stored data after a period of time.

For example, a user agent could be configured to treat third-party local storage areas as session-only storage, deleting the data once the user had closed all the [browsing contexts](#) that could access it.

This can restrict the ability of a site to track a user, as the site would then only be able to track the user across multiple sessions when they authenticate with the site itself (e.g. by making a purchase or logging in to a service).

However, this also reduces the usefulness of the API as a long-term storage mechanism. It can also put the user's data at risk, if the user does not fully understand the implications of data expiration.

### Treating persistent storage as cookies

If users attempt to protect their privacy by clearing cookies without also clearing data stored in the local storage area, sites can defeat those attempts by using the two features as redundant backup for each other. User agents should present the interfaces for clearing these in a way that helps users to understand this possibility and enables them to delete data in all persistent storage features simultaneously. [\[COOKIES\]](#)

### Site-specific safelisting of access to local storage areas

User agents may allow sites to access session storage areas in an unrestricted manner, but require the user to authorize access to local storage areas.

### Origin-tracking of stored data

User agents may record the [origins](#) of sites that contained content from third-party origins that caused data to be stored.

If this information is then used to present the view of data currently in persistent storage, it would allow the user to make informed decisions about which parts of the persistent storage to prune. Combined with a blocklist ("delete this data and prevent this domain from ever storing data again"), the user can restrict the use of persistent storage to sites that they trust.

### Shared blocklists

User agents may allow users to share their persistent storage domain blocklists.

This would allow communities to act together to protect their privacy.

While these suggestions prevent trivial use of this API for user tracking, they do not block it altogether. Within a single domain, a site can continue to track the user during a session, and can then pass all this information to the third party along with any identifying information (names, credit card numbers, addresses) obtained by the site. If a third party cooperates with multiple sites to obtain such information, a profile can still be created.

However, user tracking is to some extent possible even with no cooperation from the user agent whatsoever, for instance by using session identifiers in URLs, a technique already commonly used for innocuous purposes but easily repurposed for user tracking (even retroactively). This information can then be shared with other sites, using visitors' IP addresses and other user-specific data (e.g. user-agent headers and configuration settings) to combine separate sessions into coherent user profiles.

### 12.3.2 Sensitivity of data

User agents should treat persistently stored data as potentially sensitive; it's quite possible for emails, calendar appointments, health records, or other confidential documents to be stored in this mechanism.

To this end, user agents should ensure that when deleting data, it is promptly deleted from the underlying storage.

## 12.4 Security

### 12.4.1 DNS spoofing attacks

Because of the potential for DNS spoofing attacks, one cannot guarantee that a host claiming to be in a certain domain really is from that domain. To mitigate this, pages can use TLS. Pages using TLS can be sure that only the user, software working on behalf of the user, and other pages using TLS that have certificates identifying them as being from the same domain, can access their storage areas.

### 12.4.2 Cross-directory attacks

Different authors sharing one host name, for example users hosting content on the now defunct **geocities.com**, all share one local storage object. There is no feature to restrict the access by pathname. Authors on shared hosts are therefore urged to avoid using these features, as it would be trivial for other authors to read the data and overwrite it.

Even if a path-restriction feature was made available, the usual DOM scripting security model would make it trivial to bypass this protection and access the data from any path.

### 12.4.3 Implementation risks

The two primary risks when implementing these persistent storage features are letting hostile sites read information from other domains, and letting hostile sites write information that is then read from other domains.

Letting third-party sites read data that is not supposed to be read from their domain causes *information leakage*. For example, a user's shopping wishlist on one domain could be used by another domain for targeted advertising; or a user's work-in-progress confidential documents stored by a word-processing site could be examined by the site of a competing company.

Letting third-party sites write data to the persistent storage of other domains can result in *information spoofing*, which is equally dangerous. For example, a hostile site could add items to a user's wishlist; or a hostile site could set a user's session identifier to a known ID that the hostile site can then use to track the user's actions on the victim site.

Thus, strictly following the [origin](#) model described in this specification is important for user security.

## 13 The HTML syntax

This section only describes the rules for resources labeled with an [HTML MIME type](#). Rules for XML resources are discussed in the section below entitled "[The XML syntax](#)".

### 13.1 Writing HTML documents

*This section only applies to documents, authoring tools, and markup generators. In particular, it does not apply to conformance checkers; conformance checkers must use the requirements given in the next section ("parsing HTML documents").*

Documents must consist of the following parts, in the given order:

1. Optionally, a single U+FEFF BYTE ORDER MARK (BOM) character.
2. Any number of [comments](#) and [ASCII whitespace](#).
3. A [DOCTYPE](#).
4. Any number of [comments](#) and [ASCII whitespace](#).
5. The [document element](#), in the form of an [html element](#).
6. Any number of [comments](#) and [ASCII whitespace](#).

The various types of content mentioned above are described in the next few sections.

In addition, there are some restrictions on how [character encoding declarations](#) are to be serialized, as discussed in the section on that topic.

[ASCII whitespace](#) before the [html](#) element, at the start of the [html](#) element and before the [head](#) element, will be dropped when the document is parsed; [ASCII whitespace](#) after the [html](#) element will be parsed as if it were at the end of the [body](#) element. Thus, [ASCII whitespace](#) around the [document element](#) does not round-trip.

It is suggested that newlines be inserted after the DOCTYPE, after any comments that are before the document element, after the [html](#) element's start tag (if it is not [omitted](#)), and after any comments that are inside the [html](#) element but before the [head](#) element.

Many strings in the HTML syntax (e.g. the names of elements and their attributes) are case-insensitive, but only for [ASCII upper alphas](#) and [ASCII lower alphas](#). For convenience, in this section this is just referred to as "case-insensitive".

### 13.1.1 The DOCTYPE

A *DOCTYPE* is a required preamble.

DOCTYPES are required for legacy reasons. When omitted, browsers tend to use a different rendering mode that is incompatible with some specifications. Including the DOCTYPE in a document ensures that the browser makes a best-effort attempt at following the relevant specifications.

A DOCTYPE must consist of the following components, in this order:

1. A string that is an [ASCII case-insensitive](#) match for the string "<!DOCTYPE".
2. One or more [ASCII whitespace](#).
3. A string that is an [ASCII case-insensitive](#) match for the string "html".
4. Optionally, a [DOCTYPE legacy string](#).
5. Zero or more [ASCII whitespace](#).
6. A U+003E GREATER-THAN SIGN character (>).

In other words, <!DOCTYPE html>, case-insensitively.

---

For the purposes of HTML generators that cannot output HTML markup with the short DOCTYPE "<!DOCTYPE html>", a *DOCTYPE legacy string* may be inserted into the DOCTYPE (in the position defined above). This string must consist of:

1. One or more [ASCII whitespace](#).
2. A string that is an [ASCII case-insensitive](#) match for the string "SYSTEM".
3. One or more [ASCII whitespace](#).
4. A U+0022 QUOTATION MARK or U+0027 APOSTROPHE character (the *quote mark*).
5. The literal string "[about:legacy-compat](#)".
6. A matching U+0022 QUOTATION MARK or U+0027 APOSTROPHE character (i.e. the same character as in the earlier step labeled *quote mark*).

In other words, <!DOCTYPE html SYSTEM "about:legacy-compat"> or <!DOCTYPE html SYSTEM 'about:legacy-compat'>, case-insensitively except for the part in single or double quotes.

The [DOCTYPE legacy string](#) should not be used unless the document is generated from a system that cannot output the shorter string.

### 13.1.2 Elements

There are six different kinds of *elements*: [void elements](#), [the template element](#), [raw text elements](#), [escapable raw text elements](#), [foreign elements](#), and [normal elements](#).

#### *Void elements*

[area](#), [base](#), [br](#), [col](#), [embed](#), [hr](#), [img](#), [input](#), [link](#), [meta](#), [param](#), [source](#), [track](#), [wbr](#)

*The [template](#) element*

## [template](#)

*Raw text elements*

### [script](#), [style](#)

*Escapable raw text elements*

### [textarea](#), [title](#)

*Foreign elements*

Elements from the [MathML namespace](#) and the [SVG namespace](#).

*Normal elements*

All other allowed [HTML elements](#) are normal elements.

Tags are used to delimit the start and end of elements in the markup. [Raw text](#), [escapable raw text](#), and [normal](#) elements have a [start tag](#) to indicate where they begin, and an [end tag](#) to indicate where they end. The start and end tags of certain [normal elements](#) can be [omitted](#), as described below in the section on [optional tags](#). Those that cannot be omitted must not be omitted. [Void elements](#) only have a start tag; end tags must not be specified for [void elements](#). [Foreign elements](#) must either have a start tag and an end tag, or a start tag that is marked as self-closing, in which case they must not have an end tag.

The [contents](#) of the element must be placed between just after the start tag (which [might be implied, in certain cases](#)) and just before the end tag (which again, [might be implied in certain cases](#)). The exact allowed contents of each individual element depend on the [content model](#) of that element, as described earlier in this specification. Elements must not contain content that their content model disallows. In addition to the restrictions placed on the contents by those content models, however, the five types of elements have additional [syntactic](#) requirements.

[Void elements](#) can't have any contents (since there's no end tag, no content can be put between the start tag and the end tag).

The [template](#) element can have [template contents](#), but such [template contents](#) are not children of the [template](#) element itself. Instead, they are stored in a [DocumentFragment](#) associated with a different [Document](#) — without a [browsing context](#) — so as to avoid the [template](#) contents interfering with the main [Document](#). The markup for the [template](#) contents of a [template](#) element is placed just after the [template](#) element's start tag and just before [template](#) element's end tag (as with other elements), and may consist of any [text](#), [character references](#), [elements](#), and [comments](#), but the text must not contain the character U+003C LESS-THAN SIGN (<) or an [ambiguous ampersand](#).

[Raw text elements](#) can have [text](#), though it has [restrictions](#) described below.

[Escapable raw text elements](#) can have [text](#) and [character references](#), but the text must not contain an [ambiguous ampersand](#). There are also [further restrictions](#) described below.

[Foreign elements](#) whose start tag is marked as self-closing can't have any contents (since, again,

as there's no end tag, no content can be put between the start tag and the end tag). [Foreign elements](#) whose start tag is *not* marked as self-closing can have [text](#), [character references](#), [CDATA sections](#), other [elements](#), and [comments](#), but the text must not contain the character U+003C LESS-THAN SIGN (<) or an [ambiguous ampersand](#).

The HTML syntax does not support namespace declarations, even in [foreign elements](#).

For instance, consider the following HTML fragment:

```
<p>
 <svg>
 <metadata>
 <!-- this is invalid -->
 <cdr:license xmlns:cdr="https://www.example.com/cdr/metadata" name="MIT"/>
 </metadata>
 </svg>
</p>
```

The innermost element, **cdr:license**, is actually in the SVG namespace, as the "xmlns:cdr" attribute has no effect (unlike in XML). In fact, as the comment in the fragment above says, the fragment is actually non-conforming. This is because *SVG 2* does not define any elements called "**cdr:license**" in the SVG namespace.

[Normal elements](#) can have [text](#), [character references](#), other [elements](#), and [comments](#), but the text must not contain the character U+003C LESS-THAN SIGN (<) or an [ambiguous ampersand](#). Some [normal elements](#) also have [yet more restrictions](#) on what content they are allowed to hold, beyond the restrictions imposed by the content model and those described in this paragraph. Those restrictions are described below.

Tags contain a *tag name*, giving the element's name. HTML elements all have names that only use [ASCII alphanumerics](#). In the HTML syntax, tag names, even those for [foreign elements](#), may be written with any mix of lower- and uppercase letters that, when converted to all-lowercase, matches the element's tag name; tag names are case-insensitive.

#### 13.1.2.1 Start tags

*Start tags* must have the following format:

1. The first character of a start tag must be a U+003C LESS-THAN SIGN character (<).
2. The next few characters of a start tag must be the element's [tag name](#).
3. If there are to be any attributes in the next step, there must first be one or more [ASCII whitespace](#).
4. Then, the start tag may have a number of attributes, the [syntax for which](#) is described below. Attributes must be separated from each other by one or more [ASCII whitespace](#).
5. After the attributes, or after the [tag name](#) if there are no attributes, there may be one or more [ASCII whitespace](#). (Some attributes are required to be followed by a space. See the [attributes section](#) below.)

6. Then, if the element is one of the [void elements](#), or if the element is a [foreign element](#), then there may be a single U+002F SOLIDUS character (/). This character has no effect on [void elements](#), but on [foreign elements](#) it marks the start tag as self-closing.
7. Finally, start tags must be closed by a U+003E GREATER-THAN SIGN character (>).

### 13.1.2.2 End tags

*End tags* must have the following format:

1. The first character of an end tag must be a U+003C LESS-THAN SIGN character (<).
2. The second character of an end tag must be a U+002F SOLIDUS character (/).
3. The next few characters of an end tag must be the element's [tag name](#).
4. After the tag name, there may be one or more [ASCII whitespace](#).
5. Finally, end tags must be closed by a U+003E GREATER-THAN SIGN character (>).

### 13.1.2.3 Attributes

*Attributes* for an element are expressed inside the element's start tag.

Attributes have a name and a value. *Attribute names* must consist of one or more characters other than [controls](#), U+0020 SPACE, U+0022 ("), U+0027 ('), U+003E (>), U+002F (/), U+003D (=), and [noncharacters](#). In the HTML syntax, attribute names, even those for [foreign elements](#), may be written with any mix of [ASCII lower](#) and [ASCII upper alphas](#).

*Attribute values* are a mixture of [text](#) and [character references](#), except with the additional restriction that the text cannot contain an [ambiguous ampersand](#).

Attributes can be specified in four different ways:

#### Empty attribute syntax

Just the [attribute name](#). The value is implicitly the empty string.

In the following example, the [disabled](#) attribute is given with the empty attribute syntax:

```
<input disabled>
```

If an attribute using the empty attribute syntax is to be followed by another attribute, then there must be [ASCII whitespace](#) separating the two.

#### Unquoted attribute value syntax

The [attribute name](#), followed by zero or more [ASCII whitespace](#), followed by a single U+003D EQUALS SIGN character, followed by zero or more [ASCII whitespace](#), followed by the [attribute value](#), which, in addition to the requirements given above for attribute values, must not contain any literal [ASCII whitespace](#), any U+0022 QUOTATION MARK

characters ("), U+0027 APOSTROPHE characters ('), U+003D EQUALS SIGN characters (=), U+003C LESS-THAN SIGN characters (<), U+003E GREATER-THAN SIGN characters (>), or U+0060 GRAVE ACCENT characters (`), and must not be the empty string.

In the following example, the [value](#) attribute is given with the unquoted attribute value syntax:

```
<input value=yes>
```

If an attribute using the unquoted attribute syntax is to be followed by another attribute or by the optional U+002F SOLIDUS character (/) allowed in step 6 of the [start tag](#) syntax above, then there must be [ASCII whitespace](#) separating the two.

### Single-quoted attribute value syntax

The [attribute name](#), followed by zero or more [ASCII whitespace](#), followed by a single U+003D EQUALS SIGN character, followed by zero or more [ASCII whitespace](#), followed by a single U+0027 APOSTROPHE character ('), followed by the [attribute value](#), which, in addition to the requirements given above for attribute values, must not contain any literal U+0027 APOSTROPHE characters ('), and finally followed by a second single U+0027 APOSTROPHE character (').

In the following example, the [type](#) attribute is given with the single-quoted attribute value syntax:

```
<input type='checkbox'>
```

If an attribute using the single-quoted attribute syntax is to be followed by another attribute, then there must be [ASCII whitespace](#) separating the two.

### Double-quoted attribute value syntax

The [attribute name](#), followed by zero or more [ASCII whitespace](#), followed by a single U+003D EQUALS SIGN character, followed by zero or more [ASCII whitespace](#), followed by a single U+0022 QUOTATION MARK character ("), followed by the [attribute value](#), which, in addition to the requirements given above for attribute values, must not contain any literal U+0022 QUOTATION MARK characters ("), and finally followed by a second single U+0022 QUOTATION MARK character (").

In the following example, the [name](#) attribute is given with the double-quoted attribute value syntax:

```
<input name="be evil">
```

If an attribute using the double-quoted attribute syntax is to be followed by another attribute, then there must be [ASCII whitespace](#) separating the two.

There must never be two or more attributes on the same start tag whose names are an [ASCII case-insensitive](#) match for each other.

---

When a [foreign element](#) has one of the namespaced attributes given by the local name and namespace of the first and second cells of a row from the following table, it must be written using the name given by the third cell from the same row.

Local name	Namespace	Attribute name
actuate	XLink namespace	xlink:actuate
arcrole	XLink namespace	xlink:arcrole
href	XLink namespace	xlink:href
role	XLink namespace	xlink:role
show	XLink namespace	xlink:show
title	XLink namespace	xlink:title
type	XLink namespace	xlink:type
lang	XML namespace	xml:lang
space	XML namespace	xml:space
xmlns	XMLNS namespace	xmlns
xlink	XMLNS namespace	xmlns:xlink

No other namespaced attribute can be expressed in [the HTML syntax](#).

Whether the attributes in the table above are conforming or not is defined by other specifications (e.g. *SVG 2* and *MathML*); this section only describes the syntax rules if the attributes are serialized using the HTML syntax.

#### 13.1.2.4 Optional tags

Certain tags can be *omitted*.

Omitting an element's [start tag](#) in the situations described below does not mean the element is not present; it is implied, but it is still there. For example, an HTML document always has a root [html](#) element, even if the string `<html>` doesn't appear anywhere in the markup.

An [html](#) element's [start tag](#) may be omitted if the first thing inside the [html](#) element is not a [comment](#).

For example, in the following case it's ok to remove the "`<html>`" tag:

```
<!DOCTYPE HTML>
<html>
 <head>
 <title>Hello</title>
 </head>
```

```
<body>
 <p>Welcome to this example.</p>
</body>
</html>
```

Doing so would make the document look like this:

```
<!DOCTYPE HTML>

<head>
 <title>Hello</title>
</head>
<body>
 <p>Welcome to this example.</p>
</body>
</html>
```

This has the exact same DOM. In particular, note that whitespace around the [document element](#) is ignored by the parser. The following example would also have the exact same DOM:

```
<!DOCTYPE HTML><head>
 <title>Hello</title>
</head>
<body>
 <p>Welcome to this example.</p>
</body>
</html>
```

However, in the following example, removing the start tag moves the comment to before the [html](#) element:

```
<!DOCTYPE HTML>
<html>
 <!-- where is this comment in the DOM? -->
 <head>
 <title>Hello</title>
 </head>
 <body>
 <p>Welcome to this example.</p>
 </body>
</html>
```

With the tag removed, the document actually turns into the same as this:

```
<!DOCTYPE HTML>
<!-- where is this comment in the DOM? -->
<html>
```

```
<head>
 <title>Hello</title>
</head>
<body>
 <p>Welcome to this example.</p>
</body>
</html>
```

This is why the tag can only be removed if it is not followed by a comment: removing the tag when there is a comment there changes the document's resulting parse tree. Of course, if the position of the comment does not matter, then the tag can be omitted, as if the comment had been moved to before the start tag in the first place.

An [html](#) element's [end tag](#) may be omitted if the [html](#) element is not immediately followed by a [comment](#).

A [head](#) element's [start tag](#) may be omitted if the element is empty, or if the first thing inside the [head](#) element is an element.

A [head](#) element's [end tag](#) may be omitted if the [head](#) element is not immediately followed by [ASCII whitespace](#) or a [comment](#).

A [body](#) element's [start tag](#) may be omitted if the element is empty, or if the first thing inside the [body](#) element is not [ASCII whitespace](#) or a [comment](#), except if the first thing inside the [body](#) element is a [meta](#), [link](#), [script](#), [style](#), or [template](#) element.

A [body](#) element's [end tag](#) may be omitted if the [body](#) element is not immediately followed by a [comment](#).

Note that in the example above, the [head](#) element start and end tags, and the [body](#) element start tag, can't be omitted, because they are surrounded by whitespace:

```
<!DOCTYPE HTML>
<html>
 <head>
 <title>Hello</title>
 </head>
 <body>
 <p>Welcome to this example.</p>
 </body>
</html>
```

(The [body](#) and [html](#) element end tags could be omitted without trouble; any spaces after those get parsed into the [body](#) element anyway.)

Usually, however, whitespace isn't an issue. If we first remove the whitespace we don't care about:

```
<!DOCTYPE HTML><html><head><title>Hello</title></head><body><p>Welcome to thi
```

Then we can omit a number of tags without affecting the DOM:

```
<!DOCTYPE HTML><title>Hello</title><p>Welcome to this example.</p>
```

At that point, we can also add some whitespace back:

```
<!DOCTYPE HTML>
<title>Hello</title>
<p>Welcome to this example.</p>
```

This would be equivalent to this document, with the omitted tags shown in their parser-implied positions; the only whitespace text node that results from this is the newline at the end of the [head](#) element:

```
<!DOCTYPE HTML>
<html><head><title>Hello</title>
</head><body><p>Welcome to this example.</p></body></html>
```

An [li](#) element's [end tag](#) may be omitted if the [li](#) element is immediately followed by another [li](#) element or if there is no more content in the parent element.

A [dt](#) element's [end tag](#) may be omitted if the [dt](#) element is immediately followed by another [dt](#) element or a [dd](#) element.

A [dd](#) element's [end tag](#) may be omitted if the [dd](#) element is immediately followed by another [dd](#) element or a [dt](#) element, or if there is no more content in the parent element.

A [p](#) element's [end tag](#) may be omitted if the [p](#) element is immediately followed by an [address](#), [article](#), [aside](#), [blockquote](#), [details](#), [div](#), [dl](#), [fieldset](#), [figcaption](#), [figure](#), [footer](#), [form](#), [h1](#), [h2](#), [h3](#), [h4](#), [h5](#), [h6](#), [header](#), [hgroup](#), [hr](#), [main](#), [menu](#), [nav](#), [ol](#), [p](#), [pre](#), [section](#), [table](#), or [ul](#) element, or if there is no more content in the parent element and the parent element is an [HTML element](#) that is not an [a](#), [audio](#), [del](#), [ins](#), [map](#), [noscript](#), or [video](#) element, or an [autonomous custom element](#).

We can thus simplify the earlier example further:

```
<!DOCTYPE HTML><title>Hello</title><p>Welcome to this example.
```

An [rt](#) element's [end tag](#) may be omitted if the [rt](#) element is immediately followed by an [rt](#) or [rp](#) element, or if there is no more content in the parent element.

An [rp](#) element's [end tag](#) may be omitted if the [rp](#) element is immediately followed by an [rt](#) or [rp](#) element, or if there is no more content in the parent element.

An [optgroup](#) element's [end tag](#) may be omitted if the [optgroup](#) element is immediately

followed by another [optgroup](#) element, or if there is no more content in the parent element.

An [option](#) element's [end tag](#) may be omitted if the [option](#) element is immediately followed by another [option](#) element, or if it is immediately followed by an [optgroup](#) element, or if there is no more content in the parent element.

A [colgroup](#) element's [start tag](#) may be omitted if the first thing inside the [colgroup](#) element is a [col](#) element, and if the element is not immediately preceded by another [colgroup](#) element whose [end tag](#) has been omitted. (It can't be omitted if the element is empty.)

A [colgroup](#) element's [end tag](#) may be omitted if the [colgroup](#) element is not immediately followed by [ASCII whitespace](#) or a [comment](#).

A [caption](#) element's [end tag](#) may be omitted if the [caption](#) element is not immediately followed by [ASCII whitespace](#) or a [comment](#).

A [thead](#) element's [end tag](#) may be omitted if the [thead](#) element is immediately followed by a [tbody](#) or [tfoot](#) element.

A [tbody](#) element's [start tag](#) may be omitted if the first thing inside the [tbody](#) element is a [tr](#) element, and if the element is not immediately preceded by a [tbody](#), [thead](#), or [tfoot](#) element whose [end tag](#) has been omitted. (It can't be omitted if the element is empty.)

A [tbody](#) element's [end tag](#) may be omitted if the [tbody](#) element is immediately followed by a [tbody](#) or [tfoot](#) element, or if there is no more content in the parent element.

A [tfoot](#) element's [end tag](#) may be omitted if there is no more content in the parent element.

A [tr](#) element's [end tag](#) may be omitted if the [tr](#) element is immediately followed by another [tr](#) element, or if there is no more content in the parent element.

A [td](#) element's [end tag](#) may be omitted if the [td](#) element is immediately followed by a [td](#) or [th](#) element, or if there is no more content in the parent element.

A [th](#) element's [end tag](#) may be omitted if the [th](#) element is immediately followed by a [td](#) or [th](#) element, or if there is no more content in the parent element.

The ability to omit all these table-related tags makes table markup much terser.

Take this example:

```
<table>
 <caption>37547 TEE Electric Powered Rail Car Train Functions (Abbreviated)</caption>
 <colgroup><col><col><col></colgroup>
 <thead>
 <tr>
 <th>Function</th>
```

```

<th>Control Unit</th>
<th>Central Station</th>
</tr>
</thead>
<tbody>
<tr>
 <td>Headlights</td>
 <td>✓</td>
 <td>✓</td>
</tr>
<tr>
 <td>Interior Lights</td>
 <td>✓</td>
 <td>✓</td>
</tr>
<tr>
 <td>Electric locomotive operating sounds</td>
 <td>✓</td>
 <td>✓</td>
</tr>
<tr>
 <td>Engineer's cab lighting</td>
 <td></td>
 <td>✓</td>
</tr>
<tr>
 <td>Station Announcements - Swiss</td>
 <td></td>
 <td>✓</td>
</tr>
</tbody>
</table>

```

The exact same table, modulo some whitespace differences, could be marked up as follows:

```



```

```

<td>✓
<tr>
<td>Interior Lights
<td>✓
<td>✓
<tr>
<td>Electric locomotive operating sounds
<td>✓
<td>✓
<tr>
<td>Engineer's cab lighting
<td>
<td>✓
<tr>
<td>Station Announcements - Swiss
<td>
<td>✓
</table>

```

Since the cells take up much less room this way, this can be made even terser by having each row on one line:

```

<table>
<caption>37547 TEE Electric Powered Rail Car Train Functions (Abbreviated)
<colgroup><col><col><col>
<thead>
<tr> <th>Function <th>Control Unit <th>Cen
<tbody>
<tr> <td>Headlights <td>✓ <td>✓
<tr> <td>Interior Lights <td>✓ <td>✓
<tr> <td>Electric locomotive operating sounds <td>✓ <td>✓
<tr> <td>Engineer's cab lighting <td> <td>✓
<tr> <td>Station Announcements - Swiss <td> <td>✓
</table>

```

The only differences between these tables, at the DOM level, is with the precise position of the (in any case semantically-neutral) whitespace.

However, a [start tag](#) must never be omitted if it has any attributes.

Returning to the earlier example with all the whitespace removed and then all the optional tags removed:

```
<!DOCTYPE HTML><title>Hello</title><p>Welcome to this example.
```

If the [body](#) element in this example had to have a [class](#) attribute and the [html](#) element had to have a [lang](#) attribute, the markup would have to become:

```
<!DOCTYPE HTML><html lang="en"><title>Hello</title><body class="demo"><p>Welc
```

This section assumes that the document is conforming, in particular, that there are no [content model](#) violations. Omitting tags in the fashion described in this section in a document that does not conform to the [content models](#) described in this specification is likely to result in unexpected DOM differences (this is, in part, what the content models are designed to avoid).

### 13.1.2.5 Restrictions on content models

For historical reasons, certain elements have extra restrictions beyond even the restrictions given by their content model.

A [table](#) element must not contain [tr](#) elements, even though these elements are technically allowed inside [table](#) elements according to the content models described in this specification. (If a [tr](#) element is put inside a [table](#) in the markup, it will in fact imply a [tbody](#) start tag before it.)

A single [newline](#) may be placed immediately after the [start tag](#) of [pre](#) and [textarea](#) elements. This does not affect the processing of the element. The otherwise optional [newline](#) must be included if the element's contents themselves start with a [newline](#) (because otherwise the leading newline in the contents would be treated like the optional newline, and ignored).

The following two [pre](#) blocks are equivalent:

```
<pre>Hello</pre>
```

```
<pre>
Hello</pre>
```

### 13.1.2.6 Restrictions on the contents of raw text and escapable raw text elements

The text in [raw text](#) and [escapable raw text elements](#) must not contain any occurrences of the string "</" (U+003C LESS-THAN SIGN, U+002F SOLIDUS) followed by characters that case-insensitively match the tag name of the element followed by one of U+0009 CHARACTER TABULATION (tab), U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), U+0020 SPACE, U+003E GREATER-THAN SIGN (>), or U+002F SOLIDUS (/).

## 13.1.3 Text

*Text* is allowed inside elements, attribute values, and comments. Extra constraints are placed on what is and what is not allowed in text based on where the text is to be put, as described in the other sections.

### 13.1.3.1 Newlines

Newlines in HTML may be represented either as U+000D CARRIAGE RETURN (CR)

characters, U+000A LINE FEED (LF) characters, or pairs of U+000D CARRIAGE RETURN (CR), U+000A LINE FEED (LF) characters in that order.

Where [character references](#) are allowed, a character reference of a U+000A LINE FEED (LF) character (but not a U+000D CARRIAGE RETURN (CR) character) also represents a [newline](#).

### 13.1.4 Character references

In certain cases described in other sections, [text](#) may be mixed with *character references*. These can be used to escape characters that couldn't otherwise legally be included in [text](#).

Character references must start with a U+0026 AMPERSAND character (&). Following this, there are three possible kinds of character references:

#### Named character references

The ampersand must be followed by one of the names given in the [named character references](#) section, using the same case. The name must be one that is terminated by a U+003B SEMICOLON character (;).

#### Decimal numeric character reference

The ampersand must be followed by a U+0023 NUMBER SIGN character (#), followed by one or more [ASCII digits](#), representing a base-ten integer that corresponds to a code point that is allowed according to the definition below. The digits must then be followed by a U+003B SEMICOLON character (;).

#### Hexadecimal numeric character reference

The ampersand must be followed by a U+0023 NUMBER SIGN character (#), which must be followed by either a U+0078 LATIN SMALL LETTER X character (x) or a U+0058 LATIN CAPITAL LETTER X character (X), which must then be followed by one or more [ASCII hex digits](#), representing a hexadecimal integer that corresponds to a code point that is allowed according to the definition below. The digits must then be followed by a U+003B SEMICOLON character (;).

The numeric character reference forms described above are allowed to reference any code point excluding U+000D CR, [noncharacters](#), and [controls](#) other than [ASCII whitespace](#).

An *ambiguous ampersand* is a U+0026 AMPERSAND character (&) that is followed by one or more [ASCII alphanumerics](#), followed by a U+003B SEMICOLON character (;), where these characters do not match any of the names given in the [named character references](#) section.

### 13.1.5 CDATA sections

*CDATA sections* must consist of the following components, in this order:

1. The string "<! [CDATA[".
2. Optionally, [text](#), with the additional restriction that the text must not contain the string "]]>".

3. The string "]]>".

CDATA sections can only be used in foreign content (MathML or SVG). In this example, a CDATA section is used to escape the contents of a [MathML ms](#) element:

```
<p>You can add a string to a number, but this stringifies the number:</p>
<math>
 <ms><! [CDATA[x<y]]></ms>
 <mo>+</mo>
 <mn>3</mn>
 <mo>=</mo>
 <ms><! [CDATA[x<y3]]></ms>
</math>
```

### 13.1.6 Comments

*Comments* must have the following format:

1. The string "<!--".
2. Optionally, [text](#), with the additional restriction that the text must not start with the string ">", nor start with the string "->", nor contain the strings "<!--", "-->", or "--!>", nor end with the string "<!--".
3. The string "-->".

The [text](#) is allowed to end with the string "<!", as in <!--My favorite operators are > and <!-->.

## 13.2 Parsing HTML documents

*This section only applies to user agents, data mining tools, and conformance checkers.*

The rules for parsing XML documents into DOM trees are covered by the next section, entitled "[The XML syntax](#)".

User agents must use the parsing rules described in this section to generate the DOM trees from [text/html](#) resources. Together, these rules define what is referred to as the *HTML parser*.

While the HTML syntax described in this specification bears a close resemblance to SGML and XML, it is a separate language with its own parsing rules.

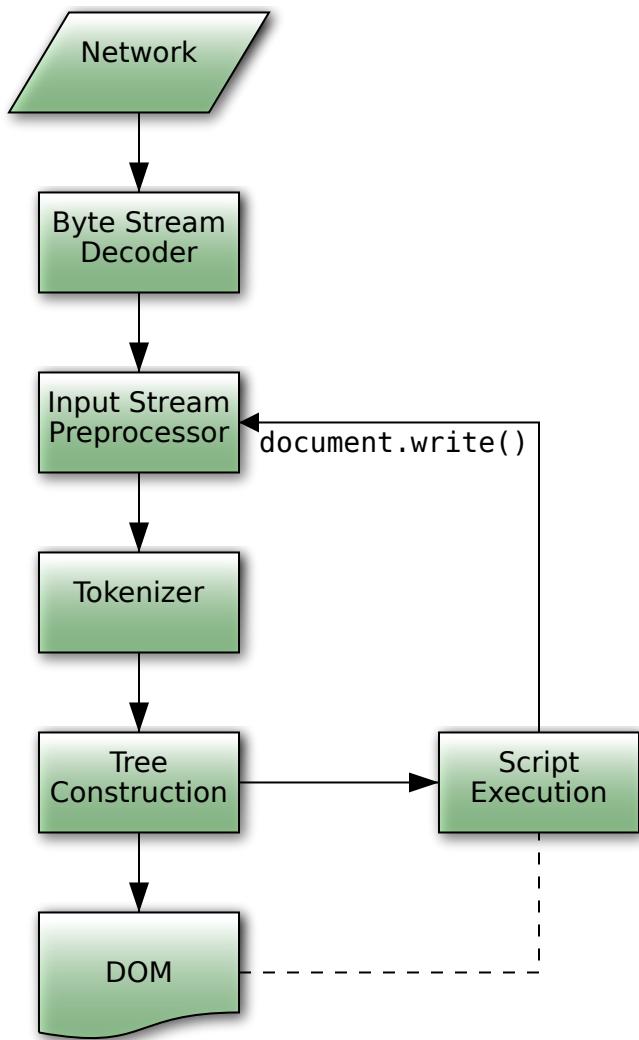
Some earlier versions of HTML (in particular from HTML2 to HTML4) were based on SGML and used SGML parsing rules. However, few (if any) web browsers ever implemented true SGML parsing for HTML documents; the only user agents to strictly handle HTML as an SGML application have historically been validators. The resulting confusion — with validators claiming documents to have one representation while widely deployed web browsers interoperably implemented a different representation — has wasted decades of productivity. This version of HTML thus returns to a non-SGML basis.

Authors interested in using SGML tools in their authoring pipeline are encouraged to use XML tools and the XML serialization of HTML.

For the purposes of conformance checkers, if a resource is determined to be in [the HTML syntax](#), then it is an [HTML document](#).

As stated [in the terminology section](#), references to [element types](#) that do not explicitly specify a namespace always refer to elements in the [HTML namespace](#). For example, if the spec talks about "a [menu](#) element", then that is an element with the local name "menu", the namespace "<http://www.w3.org/1999/xhtml>", and the interface [HTMLMenuElement](#). Where possible, references to such elements are hyperlinked to their definition.

### 13.2.1 Overview of the parsing model



The input to the HTML parsing process consists of a stream of [code points](#), which is passed through a [tokenization](#) stage followed by a [tree construction](#) stage. The output is a [Document](#) object.

Implementations that [do not support scripting](#) do not have to actually create a DOM [Document](#) object, but the DOM tree in such cases is still used as the model for the rest of the specification.

In the common case, the data handled by the tokenization stage comes from the network, but [it can also come from script](#) running in the user agent, e.g. using the [document.write\(\)](#) API.

There is only one set of states for the tokenizer stage and the tree construction stage, but the tree construction stage is reentrant, meaning that while the tree construction stage is handling one token, the tokenizer might be resumed, causing further tokens to be emitted and processed before the first token's processing is complete.

In the following example, the tree construction stage will be called upon to handle a "p" start tag token while handling the "script" end tag token:

```
...
<script>
 document.write('<p>');
</script>
...
```

To handle these cases, parsers have a *script nesting level*, which must be initially set to zero, and a *parser pause flag*, which must be initially set to false.

### 13.2.2 Parse errors

This specification defines the parsing rules for HTML documents, whether they are syntactically correct or not. Certain points in the parsing algorithm are said to be [parse errors](#). The error handling for parse errors is well-defined (that's the processing rules described throughout this specification), but user agents, while parsing an HTML document, may [abort the parser](#) at the first [parse error](#) that they encounter for which they do not wish to apply the rules described in this specification.

Conformance checkers must report at least one parse error condition to the user if one or more parse error conditions exist in the document and must not report parse error conditions if none exist in the document. Conformance checkers may report more than one parse error condition if more than one parse error condition exists in the document.

Parse errors are only errors with the *syntax* of HTML. In addition to checking for parse errors, conformance checkers will also verify that the document obeys all the other conformance requirements described in this specification.

Some parse errors have dedicated codes outlined in the table below that should be used by conformance checkers in reports.

*Error descriptions in the table below are non-normative.*

Code	Description
<i>abrupt-closing-of-empty-comment</i>	This error occurs if the parser encounters an empty <a href="#">comment</a> that is abruptly closed by a U+003E (>) <a href="#">code point</a> (i.e., <! --> or <! --->). The parser behaves as if the comment is closed correctly.
<i>abrupt-doctype-public-identifier</i>	This error occurs if the parser encounters a U+003E (>) <a href="#">code point</a> in the <a href="#">DOCTYPE</a> public identifier (e.g., <!DOCTYPE html PUBLIC "foo">). In such a case, if the DOCTYPE is correctly placed as a document preamble, the parser sets the <a href="#">Document</a> to <a href="#">quirks mode</a> .
<i>abrupt-doctype-system-identifier</i>	This error occurs if the parser encounters a U+003E (>) <a href="#">code point</a> in the <a href="#">DOCTYPE</a> system identifier (e.g., <!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01//EN" "foo">). In such a case, if the DOCTYPE is correctly placed as a document preamble, the parser sets the <a href="#">Document</a> to <a href="#">quirks mode</a> .
<i>absence-of-digits-in-numeric-character-reference</i>	This error occurs if the parser encounters a numeric <a href="#">character reference</a> that doesn't contain any digits (e.g., &#qux;). In this case the parser doesn't resolve the character reference.
<i>cdata-in-html-content</i>	This error occurs if the parser encounters a <a href="#">CDATA section</a> outside of foreign content (SVG or MathML). The parser treats such CDATA sections (including leading "[CDATA[ " and trailing " ]]" strings) as comments.
<i>character-reference-outside-unicode-range</i>	This error occurs if the parser encounters a numeric <a href="#">character reference</a> that references a <a href="#">code point</a> that is greater than the valid Unicode range. The parser resolves such a character reference to a U+FFF D REPLACEMENT CHARACTER.
<i>control-character-in-input-stream</i>	This error occurs if the <a href="#">input stream</a> contains a <a href="#">control code point</a> that is not <a href="#">ASCII whitespace</a> or U+0000 NULL. Such code points are parsed as-is and usually, where parsing rules don't apply any additional restrictions, make their way into the DOM.
<i>control-character-reference</i>	This error occurs if the parser encounters a numeric <a href="#">character reference</a> that references a <a href="#">control code point</a> that is not <a href="#">ASCII whitespace</a> or is a U+000D CARRIAGE RETURN. The parser resolves such character references as-is except C1 control references that are replaced according to the <a href="#">numeric character reference end state</a> .
<i>end-tag-with-attributes</i>	This error occurs if the parser encounters an <a href="#">end tag</a> with <a href="#">attributes</a> . Attributes in end tags are ignored and do not make their way into the DOM.
<i>duplicate-attribute</i>	This error occurs if the parser encounters an <a href="#">attribute</a> in a tag that already has an attribute with the same name. The parser ignores all such duplicate

Code	Description
<i>occurrences of the attribute.</i>	
<i>end-tag-with-trailing-solidus</i>	This error occurs if the parser encounters an <a href="#">end tag</a> that has a U+002F (/) <a href="#">code point</a> right before the closing U+003E (>) code point (e.g., </div/>). Such a tag is treated as a regular end tag.
<i>eof-before-tag-name</i>	This error occurs if the parser encounters the end of the <a href="#">input stream</a> where a tag name is expected. In this case the parser treats the beginning of a <a href="#">start tag</a> (i.e., <) or an <a href="#">end tag</a> (i.e., </) as text content.
<i>eof-in-cdata</i>	This error occurs if the parser encounters the end of the <a href="#">input stream</a> in a <a href="#">CDATA section</a> . The parser treats such CDATA sections as if they are closed immediately before the end of the input stream.
<i>eof-in-comment</i>	This error occurs if the parser encounters the end of the <a href="#">input stream</a> in a <a href="#">comment</a> . The parser treats such comments as if they are closed immediately before the end of the input stream.
<i>eof-in-doctype</i>	This error occurs if the parser encounters the end of the <a href="#">input stream</a> in a <a href="#">DOCTYPE</a> . In such a case, if the DOCTYPE is correctly placed as a document preamble, the parser sets the <a href="#">Document</a> to <a href="#">quirks mode</a> .
<i>eof-in-script-html-comment-like-text</i>	This error occurs if the parser encounters the end of the <a href="#">input stream</a> in text that resembles an <a href="#">HTML comment</a> inside <a href="#">script</a> element content (e.g., <script><!-- foo).
<i>[JAVASCRIPT]</i>	Syntactic structures that resemble HTML comments in <a href="#">script</a> elements are parsed as text content. They can be a part of a scripting language-specific syntactic structure or be treated as an HTML-like comment, if the scripting language supports them (e.g., parsing rules for HTML-like comments can be found in Annex B of the JavaScript specification). The common reason for this error is a violation of the <a href="#">restrictions for contents of script elements</a> .
<i>eof-in-tag</i>	This error occurs if the parser encounters the end of the <a href="#">input stream</a> in a <a href="#">start tag</a> or an <a href="#">end tag</a> (e.g., <div id=). Such a tag is ignored.
<i>incorrectly-closed-comment</i>	This error occurs if the parser encounters a <a href="#">comment</a> that is closed by the " -- !>" <a href="#">code point</a> sequence. The parser treats such comments as if they are correctly closed by the " -- >" code point sequence.
<i>incorrectly-opened-comment</i>	This error occurs if the parser encounters the "<!" <a href="#">code point</a> sequence that is not immediately followed by two U+002D (-) code points and that is not the start of a <a href="#">DOCTYPE</a> or a <a href="#">CDATA section</a> . All content that follows the "<!" code

Code	Description
	<p>point sequence up to a U+003E (&gt;) code point (if present) or to the end of the <a href="#">input stream</a> is treated as a comment.</p> <p>One possible cause of this error is using an XML markup declaration (e.g., <code>&lt;!ELEMENT br EMPTY&gt;</code>) in HTML.</p>
<i>invalid-character-sequence-after-doctype-name</i>	<p>This error occurs if the parser encounters any <a href="#">code point</a> sequence other than "PUBLIC" and "SYSTEM" keywords after a <a href="#">DOCTYPE</a> name. In such a case, the parser ignores any following public or system identifiers, and if the DOCTYPE is correctly placed as a document preamble, and if the <a href="#">parser cannot change the mode flag</a> is false, sets the <a href="#">Document</a> to <a href="#">quirks mode</a>.</p>
	<p>This error occurs if the parser encounters a <a href="#">code point</a> that is not an <a href="#">ASCII alpha</a> where first code point of a <a href="#">start tag</a> name or an <a href="#">end tag</a> name is expected. If a start tag was expected such code point and a preceding U+003C (&lt;) is treated as text content, and all content that follows is treated as markup. Whereas, if an end tag was expected, such code point and all content that follows up to a U+003E (&gt;) code point (if present) or to the end of the <a href="#">input stream</a> is treated as a comment.</p>
	<p>For example, consider the following markup:</p>
<i>invalid-first-character-of-tag-name</i>	<p><code>&lt;42&gt;&lt;/42&gt;</code></p> <p>This will be parsed into:</p> <ul style="list-style-type: none"> <li>• <a href="#">html</a> <ul style="list-style-type: none"> <li>◦ <a href="#">head</a></li> <li>◦ <a href="#">body</a> <ul style="list-style-type: none"> <li>▪ <a href="#">#text</a>: &lt;42&gt;</li> <li>▪ <a href="#">#comment</a>: 42</li> </ul> </li> </ul> </li> </ul>
	<p>While the first code point of a tag name is limited to an <a href="#">ASCII alpha</a>, a wide range of code points (including <a href="#">ASCII digits</a>) is allowed in subsequent positions.</p>
<i>missing-attribute-value</i>	<p>This error occurs if the parser encounters a U+003E (&gt;) <a href="#">code point</a> where an <a href="#">attribute</a> value is expected (e.g., <code>&lt;div id=&gt;</code>). The parser treats the attribute as having an empty value.</p>
<i>missing-doctype-name</i>	<p>This error occurs if the parser encounters a <a href="#">DOCTYPE</a> that is missing a name (e.g., <code>&lt;!DOCTYPE&gt;</code>). In such a case, if the DOCTYPE is correctly placed as a document preamble, the parser sets the <a href="#">Document</a> to <a href="#">quirks mode</a>.</p>
<i>missing-doctype</i>	<p>This error occurs if the parser encounters a U+003E (&gt;) <a href="#">code point</a> where start</p>

Code	Description
<i>public-identifier</i>	of the <a href="#">DOCTYPE</a> public identifier is expected (e.g., <code>&lt;!DOCTYPE html PUBLIC &gt;</code> ). In such a case, if the DOCTYPE is correctly placed as a document preamble, the parser sets the <a href="#">Document</a> to <a href="#">quirks mode</a> .
<i>missing-doctype-system-identifier</i>	This error occurs if the parser encounters a U+003E (>) <a href="#">code point</a> where start of the <a href="#">DOCTYPE</a> system identifier is expected (e.g., <code>&lt;!DOCTYPE html SYSTEM &gt;</code> ). In such a case, if the DOCTYPE is correctly placed as a document preamble, the parser sets the <a href="#">Document</a> to <a href="#">quirks mode</a> .
<i>missing-end-tag-name</i>	This error occurs if the parser encounters a U+003E (>) <a href="#">code point</a> where an <a href="#">end tag</a> name is expected, i.e., <code>&lt;/&gt;</code> . The parser ignores the whole " <code>&lt;/&gt;</code> " code point sequence.
<i>missing-quote-before-doctype-public-identifier</i>	This error occurs if the parser encounters the <a href="#">DOCTYPE</a> public identifier that is not preceded by a quote (e.g., <code>&lt;!DOCTYPE html PUBLIC -//W3C//DTD HTML 4.01//EN"&gt;</code> ). In such a case, the parser ignores the public identifier, and if the DOCTYPE is correctly placed as a document preamble, sets the <a href="#">Document</a> to <a href="#">quirks mode</a> .
<i>missing-quote-before-doctype-system-identifier</i>	This error occurs if the parser encounters the <a href="#">DOCTYPE</a> system identifier that is not preceded by a quote (e.g., <code>&lt;!DOCTYPE html SYSTEM http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd"&gt;</code> ). In such a case, the parser ignores the system identifier, and if the DOCTYPE is correctly placed as a document preamble, sets the <a href="#">Document</a> to <a href="#">quirks mode</a> .
<i>missing-semicolon-after-character-reference</i>	This error occurs if the parser encounters a <a href="#">character reference</a> that is not terminated by a U+003B (;) <a href="#">code point</a> . Usually the parser behaves as if character reference is terminated by the U+003B (;) code point; however, there are some ambiguous cases in which the parser includes subsequent code points in the character reference.  For example, <code>&amp;not;in</code> will be parsed as "¬in" whereas <code>&amp;notin</code> will be parsed as "notin".
<i>missing-whitespace-after-doctype-public-keyword</i>	This error occurs if the parser encounters a <a href="#">DOCTYPE</a> whose "PUBLIC" keyword and public identifier are not separated by <a href="#">ASCII whitespace</a> . In this case the parser behaves as if ASCII whitespace is present.
<i>missing-whitespace-after-doctype-system-</i>	This error occurs if the parser encounters a <a href="#">DOCTYPE</a> whose "SYSTEM" keyword and system identifier are not separated by <a href="#">ASCII whitespace</a> . In this case the parser behaves as if ASCII whitespace is present.

Code	Description
<i>keyword</i>	
<i>missing-</i>	
<i>whitespace-</i>	
<i>before-</i>	
<i>doctype-</i>	
<i>name</i>	This error occurs if the parser encounters a <a href="#">DOCTYPE</a> whose "DOCTYPE" keyword and name are not separated by <a href="#">ASCII whitespace</a> . In this case the parser behaves as if ASCII whitespace is present.
<i>missing-</i>	
<i>whitespace-</i>	
<i>between-</i>	
<i>attributes</i>	This error occurs if the parser encounters <a href="#">attributes</a> that are not separated by <a href="#">ASCII whitespace</a> (e.g., <code>&lt;div id="foo" class="bar"&gt;</code> ). In this case the parser behaves as if ASCII whitespace is present.
<i>missing-</i>	
<i>whitespace-</i>	
<i>between-</i>	
<i>doctype-</i>	
<i>public-and-</i>	
<i>system-</i>	
<i>identifiers</i>	This error occurs if the parser encounters a <a href="#">DOCTYPE</a> whose public and system identifiers are not separated by <a href="#">ASCII whitespace</a> . In this case the parser behaves as if ASCII whitespace is present.
<i>nested-</i>	
<i>comment</i>	This error occurs if the parser encounters a nested <a href="#">comment</a> (e.g., <code>&lt;! -- &lt;! -- nested --&gt; --&gt;</code> ). Such a comment will be closed by the first occurring " <code>--&gt;</code> " <a href="#">code point</a> sequence and everything that follows will be treated as markup.
<i>noncharacter</i>	This error occurs if the parser encounters a numeric <a href="#">character reference</a> that
<i>character-</i>	references a <a href="#">noncharacter</a> . The parser resolves such character references as-is.
<i>reference</i>	
<i>noncharacter</i>	This error occurs if the <a href="#">input stream</a> contains a <a href="#">noncharacter</a> . Such <a href="#">code points</a>
<i>in-input-</i>	are parsed as-is and usually, where parsing rules don't apply any additional
<i>stream</i>	restrictions, make their way into the DOM.
<i>non-void-</i>	
<i>html-</i>	
<i>element-</i>	
<i>start-tag-</i>	
<i>with-trailing-</i>	
<i>solidus</i>	For example, consider the following markup:
	<code>&lt;div/&gt;&lt;span&gt;&lt;/span&gt;&lt;span&gt;&lt;/span&gt;</code>
	This will be parsed into:
	<ul style="list-style-type: none"> <li>• <a href="#">html</a> <ul style="list-style-type: none"> <li>◦ <a href="#">head</a></li> <li>◦ <a href="#">body</a> <ul style="list-style-type: none"> <li>▪ <a href="#">div</a> <ul style="list-style-type: none"> <li>▪ <a href="#">span</a></li> </ul> </li> </ul> </li> </ul> </li> </ul>

Code	Description
	▪ <a href="#">span</a>
<i>null-character-reference</i>	The trailing U+002F (/) in a start tag name can be used only in foreign content to specify self-closing tags. (Self-closing tags don't exist in HTML.) It is also allowed for void elements, but doesn't have any effect in this case.
<i>surrogate-character-reference</i>	This error occurs if the parser encounters a numeric <a href="#">character reference</a> that references a U+0000 NULL <a href="#">code point</a> . The parser resolves such character references to a U+FFFD REPLACEMENT CHARACTER.
<i>surrogate-in-input-stream</i>	This error occurs if the parser encounters a numeric <a href="#">character reference</a> that references a <a href="#">surrogate</a> . The parser resolves such character references to a U+FFFD REPLACEMENT CHARACTER.
<i>surrogate-in-input-stream</i>	This error occurs if the <a href="#">input stream</a> contains a <a href="#">surrogate</a> . Such <a href="#">code points</a> are parsed as-is and usually, where parsing rules don't apply any additional restrictions, make their way into the DOM.
<i>unexpected-character-after-doctype-system-identifier</i>	Surrogates can only find their way into the input stream via script APIs such as <a href="#">document.write()</a> .
<i>unexpected-character-in-attribute-name</i>	This error occurs if the parser encounters any <a href="#">code points</a> other than <a href="#">ASCII whitespace</a> or closing U+003E (>) after the <a href="#">DOCTYPE</a> system identifier. The parser ignores these code points.
	This error occurs if the parser encounters a U+0022 ("), U+0027 ('), or U+003C (<) <a href="#">code point</a> in an <a href="#">attribute name</a> . The parser includes such code points in the attribute name.
	Code points that trigger this error are usually a part of another syntactic construct and can be a sign of a typo around the attribute name.
<i>unexpected-character-in-attribute-name</i>	For example, consider the following markup:
	<div foo<div>
	Due to a forgotten U+003E (>) code point after <code>foo</code> the parser treats this markup as a single <a href="#">div</a> element with a " <code>foo&lt;div</code> " attribute.
	As another example of this error, consider the following markup:
	<div id'bar'>

Code	Description
	<p>Due to a forgotten U+003D (=) code point between an attribute name and value the parser treats this markup as a <a href="#">div</a> element with the attribute "<b>id='bar'</b>" that has an empty value.</p>
	<p>This error occurs if the parser encounters a U+0022 ("), U+0027 ('), U+003C (&lt;), U+003D (=), or U+0060 (') <a href="#">code point</a> in an unquoted <a href="#">attribute value</a>. The parser includes such code points in the attribute value.</p>
	<p>Code points that trigger this error are usually a part of another syntactic construct and can be a sign of a typo around the attribute value.</p>
<i>unexpected-character-in-unquoted-attribute-value</i>	<p>U+0060 (') is in the list of code points that trigger this error because certain legacy user agents treat it as a quote.</p>
	<p>For example, consider the following markup:</p> <pre>&lt;div foo=b'ar'&gt;</pre>
	<p>Due to a misplaced U+0027 (') code point the parser sets the value of the "foo" attribute to "b'ar'".</p>
	<p>This error occurs if the parser encounters a U+003D (=) <a href="#">code point</a> before an attribute name. In this case the parser treats U+003D (=) as the first code point of the attribute name.</p>
<i>unexpected-equals-sign-before-attribute-name</i>	<p>The common reason for this error is a forgotten attribute name.</p>
	<p>For example, consider the following markup:</p> <pre>&lt;div foo="bar" ="baz"&gt;</pre>
	<p>Due to a forgotten attribute name the parser treats this markup as a <a href="#">div</a> element with two attributes: a "foo" attribute with a "bar" value and a "=baz" attribute with an empty value.</p>
<i>unexpected-null-character</i>	<p>This error occurs if the parser encounters a U+0000 NULL <a href="#">code point</a> in the <a href="#">input stream</a> in certain positions. In general, such code points are either ignored or, for security reasons, replaced with a U+FFFD REPLACEMENT CHARACTER.</p>
<i>unexpected-question-mark-instead-of-tag-name</i>	<p>This error occurs if the parser encounters a U+003F (?) <a href="#">code point</a> where first code point of a <a href="#">start tag</a> name is expected. The U+003F (?) and all content that follows up to a U+003E (&gt;) code point (if present) or to the end of the <a href="#">input stream</a> is treated as a comment.</p>

Code	Description
------	-------------

For example, consider the following markup:

```
<?xml-stylesheet type="text/css" href="style.css"?>
```

This will be parsed into:

- [#comment](#): ?xml-stylesheet type="text/css" href="style.css"?
- [html](#)
  - [head](#)
  - [body](#)

The common reason for this error is an XML processing instruction (e.g., `<?xml-stylesheet type="text/css" href="style.css"?>`) or an XML declaration (e.g., `<?xml version="1.0" encoding="UTF-8"?>`) being used in HTML.

*unexpected-solidus-in-tag* This error occurs if the parser encounters a U+002F (/) [code point](#) that is not a part of a quoted [attribute](#) value and not immediately followed by a U+003E (>) code point in a tag (e.g., `<div / id="foo">`). In this case the parser behaves as if it encountered [ASCII whitespace](#).

*unknown-named-character-reference* This error occurs if the parser encounters an [ambiguous ampersand](#). In this case the parser doesn't resolve the [character reference](#).

### 13.2.3 The *input byte stream*

The stream of code points that comprises the input to the tokenization stage will be initially seen by the user agent as a stream of bytes (typically coming over the network or from the local file system). The bytes encode the actual characters according to a particular *character encoding*, which the user agent uses to decode the bytes into characters.

For XML documents, the algorithm user agents are required to use to determine the character encoding is given by *XML*. This section does not apply to XML documents. [\[XML\]](#)

Usually, the [encoding sniffing algorithm](#) defined below is used to determine the character encoding.

Given a character encoding, the bytes in the [input byte stream](#) must be converted to characters for the tokenizer's [input stream](#), by passing the [input byte stream](#) and character encoding to [decode](#).

A leading Byte Order Mark (BOM) causes the character encoding argument to be ignored and will itself be skipped.

Bytes or sequences of bytes in the original byte stream that did not conform to the Encoding standard (e.g. invalid UTF-8 byte sequences in a UTF-8 input byte stream) are errors that conformance checkers are expected to report. [\[ENCODING\]](#)

The decoder algorithms describe how to handle invalid input; for security reasons, it is imperative that those rules be followed precisely. Differences in how invalid byte sequences are handled can result in, amongst other problems, script injection vulnerabilities ("XSS").

When the HTML parser is decoding an input byte stream, it uses a character encoding and a *confidence*. The confidence is either *tentative*, *certain*, or *irrelevant*. The encoding used, and whether the confidence in that encoding is *tentative* or *certain*, is [used during the parsing](#) to determine whether to [change the encoding](#). If no encoding is necessary, e.g. because the parser is operating on a Unicode stream and doesn't have to use a character encoding at all, then the [confidence](#) is *irrelevant*.

Some algorithms feed the parser by directly adding characters to the [input stream](#) rather than adding bytes to the [input byte stream](#).

#### 13.2.3.1 Parsing with a known character encoding

When the HTML parser is to operate on an input byte stream that has a *known definite encoding*, then the character encoding is that encoding and the [confidence](#) is *certain*.

#### 13.2.3.2 Determining the character encoding

In some cases, it might be impractical to unambiguously determine the encoding before parsing the document. Because of this, this specification provides for a two-pass mechanism with an optional pre-scan. Implementations are allowed, as described below, to apply a simplified parsing algorithm to whatever bytes they have available before beginning to parse the document. Then, the real parser is started, using a tentative encoding derived from this pre-parse and other out-of-band metadata. If, while the document is being loaded, the user agent discovers a character encoding declaration that conflicts with this information, then the parser can get reinvoked to perform a parse of the document with the real encoding.

User agents must use the following algorithm, called the *encoding sniffing algorithm*, to determine the character encoding to use when decoding a document in the first pass. This algorithm takes as input any out-of-band metadata available to the user agent (e.g. the [Content-Type metadata](#) of the document) and all the bytes available so far, and returns a character encoding and a [confidence](#) that is either *tentative* or *certain*.

1. If the result of [BOM sniffing](#) is an encoding, return that encoding with [confidence certain](#).

Although the [decode](#) algorithm will itself change the encoding to use based on the presence of a byte order mark, this algorithm sniffs the BOM as well in order to set the correct [document's character encoding](#) and [confidence](#).

2. If the user has explicitly instructed the user agent to override the document's character encoding with a specific encoding, optionally return that encoding with the [confidence certain](#).

Typically, user agents remember such user requests across sessions, and in some cases apply them to documents in [iframe](#)s as well.

3. The user agent may wait for more bytes of the resource to be available, either in this step or at any later step in this algorithm. For instance, a user agent might wait 500ms or 1024 bytes, whichever came first. In general preparsing the source to find the encoding improves performance, as it reduces the need to throw away the data structures used when parsing upon finding the encoding information. However, if the user agent delays too long to obtain data to determine the encoding, then the cost of the delay could outweigh any performance improvements from the prepars.

The authoring conformance requirements for character encoding declarations limit them to only appearing [in the first 1024 bytes](#). User agents are therefore encouraged to use the prescan algorithm below (as invoked by these steps) on the first 1024 bytes, but not to stall beyond that.

4. If the transport layer specifies a character encoding, and it is supported, return that encoding with the [confidence certain](#).
5. Optionally [prescan the byte stream to determine its encoding](#), with the [end condition](#) being when the user agent decides that scanning further bytes would not be efficient. User agents are encouraged to only prescan the first 1024 bytes. User agents may decide that scanning *any* bytes is not efficient, in which case these substeps are entirely skipped.

The aforementioned algorithm returns either a character encoding or failure. If it returns a character encoding, then return the same encoding, with [confidence tentative](#).

6. If the [HTML parser](#) for which this algorithm is being run is associated with a [Document](#) *d* whose [browsing context](#) is non-null and a [child browsing context](#), then:
  1. Let *parentDocument* be *d*'s [browsing context](#)'s [container document](#).
  2. If *parentDocument*'s [origin](#) is [same origin](#) with *d*'s [origin](#) and *parentDocument*'s [character encoding](#) is not [UTF-16BE/LE](#), then return *parentDocument*'s [character encoding](#), with the [confidence tentative](#).
7. Otherwise, if the user agent has information on the likely encoding for this page, e.g. based on the encoding of the page when it was last visited, then return that encoding, with the [confidence tentative](#).
8. The user agent may attempt to autodetect the character encoding from applying frequency analysis or other algorithms to the data stream. Such algorithms may use information about the resource other than the resource's contents, including the address

of the resource. If autodetection succeeds in determining a character encoding, and that encoding is a supported encoding, then return that encoding, with the [confidence tentative](#). [\[UNIVCHARDET\]](#)

User agents are generally discouraged from attempting to autodetect encodings for resources obtained over the network, since doing so involves inherently non-interoperable heuristics. Attempting to detect encodings based on an HTML document's preamble is especially tricky since HTML markup typically uses only ASCII characters, and HTML documents tend to begin with a lot of markup rather than with text content.

The UTF-8 encoding has a highly detectable bit pattern. Files from the local file system that contain bytes with values greater than 0x7F which match the UTF-8 pattern are very likely to be UTF-8, while documents with byte sequences that do not match it are very likely not. When a user agent can examine the whole file, rather than just the preamble, detecting for UTF-8 specifically can be especially effective. [\[PPUTF8\]](#) [\[UTF8DET\]](#)

9. Otherwise, return an [implementation-defined](#) or user-specified default character encoding, with the [confidence tentative](#).

In controlled environments or in environments where the encoding of documents can be prescribed (for example, for user agents intended for dedicated use in new networks), the comprehensive **UTF-8** encoding is suggested.

In other environments, the default encoding is typically dependent on the user's locale (an approximation of the languages, and thus often encodings, of the pages that the user is likely to frequent). The following table gives suggested defaults based on the user's locale, for compatibility with legacy content. Locales are identified by BCP 47 language tags. [\[BCP47\]](#) [\[ENCODING\]](#)

Locale language	Suggested default encoding
ar	<a href="#">windows-1256</a>
ba	<a href="#">windows-1251</a>
be	<a href="#">windows-1251</a>
bg	<a href="#">windows-1251</a>
cs	<a href="#">windows-1250</a>
el	<a href="#">ISO-8859-7</a>
et	<a href="#">windows-1257</a>
fa	<a href="#">windows-1256</a>
he	<a href="#">windows-1255</a>
hr	<a href="#">windows-1250</a>
hu	<a href="#">ISO-8859-2</a>
ja	<a href="#">Shift_JIS</a>
kk	<a href="#">windows-1251</a>
ko	<a href="#">EUC-KR</a>
ku	<a href="#">windows-1254</a>

Locale language	Suggested default encoding
ky	Kyrgyz <a href="#">windows-1251</a>
lt	Lithuanian <a href="#">windows-1257</a>
lv	Latvian <a href="#">windows-1257</a>
mk	Macedonian <a href="#">windows-1251</a>
pl	Polish <a href="#">ISO-8859-2</a>
ru	Russian <a href="#">windows-1251</a>
sah	Yakut <a href="#">windows-1251</a>
sk	Slovak <a href="#">windows-1250</a>
sl	Slovenian <a href="#">ISO-8859-2</a>
sr	Serbian <a href="#">windows-1251</a>
tg	Tajik <a href="#">windows-1251</a>
th	Thai <a href="#">windows-874</a>
tr	Turkish <a href="#">windows-1254</a>
tt	Tatar <a href="#">windows-1251</a>
uk	Ukrainian <a href="#">windows-1251</a>
vi	Vietnamese <a href="#">windows-1258</a>
zh-Hans, zh-CN, zh-SG	Chinese, Simplified <a href="#">GBK</a>
zh-Hant, zh-HK, zh-MO, zh-TW	Chinese, Traditional <a href="#">Big5</a>
All other locales	<a href="#">windows-1252</a>

The contents of this table are derived from the intersection of Windows, Chrome, and Firefox defaults.

The [document's character encoding](#) must immediately be set to the value returned from this algorithm, at the same time as the user agent uses the returned value to select the decoder to use for the input byte stream.

---

When an algorithm requires a user agent to *prescan a byte stream to determine its encoding*, given some defined *end condition*, then it must run the following steps. If at any point during these steps (including during instances of the [get an attribute](#) algorithm invoked by this one) the user agent either runs out of bytes (meaning the *position* pointer created in the first step below goes beyond the end of the byte stream obtained so far) or reaches its *end condition*, then abort the [prescan a byte stream to determine its encoding](#) algorithm and return the result [get an XML encoding](#) applied to the same bytes that the [prescan a byte stream to determine its encoding](#) algorithm was applied to. Otherwise, these steps will return a character encoding.

1. Let *fallback encoding* be null.
2. Let *position* be a pointer to a byte in the input byte stream, initially pointing at the first byte.
3. Prescan for UTF-16 XML declarations: If *position* points to:

A sequence of bytes starting with: 0x3C, 0x0, 0x3F, 0x0, 0x78, 0x0 (case-sensitive)

UTF-16 little-endian '<?x')

Return [UTF-16LE](#).

A sequence of bytes starting with: 0x0, 0x3C, 0x0, 0x3F, 0x0, 0x78 (case-sensitive  
UTF-16 big-endian '<?x')

Return [UTF-16BE](#).

For historical reasons, the prefix is two bytes longer than in [Appendix F](#) of *XML* and the encoding name is not checked.

4. *Loop*: If *position* points to:

A sequence of bytes starting with: 0x3C 0x21 0x2D 0x2D ('<!--')

Advance the *position* pointer so that it points at the first 0x3E byte which is preceded by two 0x2D bytes (i.e. at the end of an ASCII '-->' sequence) and comes after the 0x3C byte that was found. (The two 0x2D bytes can be the same as those in the '<!--' sequence.)

A sequence of bytes starting with: 0x3C, 0x4D or 0x6D, 0x45 or 0x65, 0x54 or 0x74, 0x41 or 0x61, and one of 0x09, 0x0A, 0x0C, 0x0D, 0x20, 0x2F (case-insensitive ASCII '<meta' followed by a space or slash)

1. Advance the *position* pointer so that it points at the next 0x09, 0x0A, 0x0C, 0x0D, 0x20, or 0x2F byte (the one in sequence of characters matched above).
2. Let *attribute list* be an empty list of strings.
3. Let *got pragma* be false.
4. Let *need pragma* be null.
5. Let *charset* be the null value (which, for the purposes of this algorithm, is distinct from an unrecognized encoding or the empty string).
6. *Attributes*: [Get an attribute](#) and its value. If no attribute was sniffed, then jump to the *processing* step below.
7. If the attribute's name is already in *attribute list*, then return to the step labeled *attributes*.
8. Add the attribute's name to *attribute list*.
9. Run the appropriate step from the following list, if one applies:

If the attribute's name is "**http-equiv**"

If the attribute's value is "**content-type**", then set *got pragma* to true.

If the attribute's name is "**content**"

Apply the [algorithm for extracting a character encoding from a meta element](#), giving the attribute's value as the string to parse. If a character encoding is returned, and if *charset* is still set to null, let *charset* be the encoding returned, and set *need pragma* to true.

If the attribute's name is "**charset**"

Let *charset* be the result of [getting an encoding](#) from the attribute's value, and set *need pragma* to false.

10. Return to the step labeled *attributes*.
11. *Processing*: If *need pragma* is null, then jump to the step below labeled *next byte*.
12. If *need pragma* is true but *got pragma* is false, then jump to the step below labeled *next byte*.
13. If *charset* is failure, then jump to the step below labeled *next byte*.
14. If *charset* is [UTF-16BE/LE](#), then set *charset* to [UTF-8](#).
15. If *charset* is [x-user-defined](#), then set *charset* to [windows-1252](#).
16. Return *charset*.

A sequence of bytes starting with a 0x3C byte (<), optionally a 0x2F byte (/), and finally a byte in the range 0x41-0x5A or 0x61-0x7A (A-Z or a-z)

1. Advance the *position* pointer so that it points at the next 0x09 (HT), 0x0A (LF), 0x0C (FF), 0x0D (CR), 0x20 (SP), or 0x3E (>) byte.
2. Repeatedly [get an attribute](#) until no further attributes can be found, then jump to the step below labeled *next byte*.

A sequence of bytes starting with: 0x3C 0x21 ('<!')

A sequence of bytes starting with: 0x3C 0x2F ('</')

A sequence of bytes starting with: 0x3C 0x3F ('<?')

Advance the *position* pointer so that it points at the first 0x3E byte (>) that comes after the 0x3C byte that was found.

Any other byte

Do nothing with that byte.

5. *Next byte*: Move *position* so it points at the next byte in the input byte stream, and return to the step above labeled *loop*.

When the [prescan a byte stream to determine its encoding](#) algorithm says to *get an attribute*, it means doing this:

1. If the byte at *position* is one of 0x09 (HT), 0x0A (LF), 0x0C (FF), 0x0D (CR), 0x20 (SP), or 0x2F (/) then advance *position* to the next byte and redo this step.
2. If the byte at *position* is 0x3E (>), then abort the [get an attribute](#) algorithm. There isn't one.
3. Otherwise, the byte at *position* is the start of the attribute name. Let *attribute name* and *attribute value* be the empty string.
4. Process the byte at *position* as follows:

If it is 0x3D (=), and the *attribute name* is longer than the empty string

Advance *position* to the next byte and jump to the step below labeled *value*.

If it is 0x09 (HT), 0x0A (LF), 0x0C (FF), 0x0D (CR), or 0x20 (SP)

Jump to the step below labeled *spaces*.

If it is 0x2F (/) or 0x3E (>)

Abort the [get an attribute](#) algorithm. The attribute's name is the value of *attribute name*, its value is the empty string.

If it is in the range 0x41 (A) to 0x5A (Z)

Append the code point  $b + 0x20$  to *attribute name* (where  $b$  is the value of the byte at *position*). (This converts the input to lowercase.)

Anything else

Append the code point with the same value as the byte at *position* to *attribute name*. (It doesn't actually matter how bytes outside the ASCII range are handled here, since only ASCII bytes can contribute to the detection of a character encoding.)

5. Advance *position* to the next byte and return to the previous step.
6. *Spaces*: If the byte at *position* is one of 0x09 (HT), 0x0A (LF), 0x0C (FF), 0x0D (CR), or 0x20 (SP) then advance *position* to the next byte, then, repeat this step.
7. If the byte at *position* is *not* 0x3D (=), abort the [get an attribute](#) algorithm. The attribute's name is the value of *attribute name*, its value is the empty string.

8. Advance *position* past the 0x3D (=) byte.
9. *Value*: If the byte at *position* is one of 0x09 (HT), 0x0A (LF), 0x0C (FF), 0x0D (CR), or 0x20 (SP) then advance *position* to the next byte, then, repeat this step.
10. Process the byte at *position* as follows:
  - If it is 0x22 ("") or 0x27 ('')
    1. Let *b* be the value of the byte at *position*.
    2. *Quote loop*: Advance *position* to the next byte.
    3. If the value of the byte at *position* is the value of *b*, then advance *position* to the next byte and abort the "get an attribute" algorithm. The attribute's name is the value of *attribute name*, and its value is the value of *attribute value*.
    4. Otherwise, if the value of the byte at *position* is in the range 0x41 (A) to 0x5A (Z), then append a code point to *attribute value* whose value is 0x20 more than the value of the byte at *position*.
    5. Otherwise, append a code point to *attribute value* whose value is the same as the value of the byte at *position*.
    6. Return to the step above labeled *quote loop*.
  - If it is 0x3E (>)
 

Abort the [get an attribute](#) algorithm. The attribute's name is the value of *attribute name*, its value is the empty string.
  - If it is in the range 0x41 (A) to 0x5A (Z)
 

Append a code point *b*+0x20 to *attribute value* (where *b* is the value of the byte at *position*). Advance *position* to the next byte.
  - Anything else
 

Append a code point with the same value as the byte at *position* to *attribute value*. Advance *position* to the next byte.

11. Process the byte at *position* as follows:

If it is 0x09 (HT), 0x0A (LF), 0x0C (FF), 0x0D (CR), 0x20 (SP), or 0x3E (>)

Abort the [get an attribute](#) algorithm. The attribute's name is the value of *attribute name* and its value is the value of *attribute value*.

If it is in the range 0x41 (A) to 0x5A (Z)

Append a code point *b*+0x20 to *attribute value* (where *b* is the value of the byte at *position*).

Anything else

Append a code point with the same value as the byte at *position* to *attribute value*.

12. Advance *position* to the next byte and return to the previous step.

When the [prescan a byte stream to determine its encoding](#) algorithm is aborted without returning an encoding, *get an XML encoding* means doing this.

Looking for syntax resembling an XML declaration, even in [text/html](#), is necessary for compatibility with existing content.

1. Let *encodingPosition* be a pointer to the start of the stream.
2. If *encodingPosition* does not point to the start of a byte sequence 0x3C, 0x3F, 0x78, 0x6D, 0x6C ('<?xml'), then return failure.
3. Let *xmlDeclarationEnd* be a pointer to the next byte in the input byte stream which is 0x3E (>). If there is no such byte, then return failure.
4. Set *encodingPosition* to the position of the first occurrence of the subsequence of bytes 0x65, 0x6E, 0x63, 0x6F, 0x64, 0x69, 0x6E, 0x67 ('encoding') at or after the current *encodingPosition*. If there is no such sequence, then return failure.
5. Advance *encodingPosition* past the 0x67 (g) byte.
6. While the byte at *encodingPosition* is less than or equal to 0x20 (i.e., it is either an ASCII space or control character), advance *encodingPosition* to the next byte.
7. If the byte at *encodingPosition* is not 0x3D (=), then return failure.
8. Advance *encodingPosition* to the next byte.
9. While the byte at *encodingPosition* is less than or equal to 0x20 (i.e., it is either an ASCII space or control character), advance *encodingPosition* to the next byte.
10. Let *quoteMark* be the byte at *encodingPosition*.
11. If *quoteMark* is not either 0x22 ("") or 0x27 (''), then return failure.
12. Advance *encodingPosition* to the next byte.
13. Let *encodingEndPosition* be the position of the next occurrence of *quoteMark* at or after *encodingPosition*. If *quoteMark* does not occur again, then return failure.
14. Let *potentialEncoding* be the sequence of the bytes between *encodingPosition* (inclusive) and *encodingEndPosition* (exclusive).
15. If *potentialEncoding* contains one or more bytes whose byte value is 0x20 or below, then return failure.
16. Let *encoding* be the result of [getting an encoding](#) given *potentialEncoding* [isomorphic decoded](#).

17. If the *encoding* is [UTF-16BE/LE](#), then change it to [UTF-8](#).

18. Return *encoding*.

For the sake of interoperability, user agents should not use a pre-scan algorithm that returns different results than the one described above. (But, if you do, please at least let us know, so that we can improve this algorithm and benefit everyone...)

#### 13.2.3.3 Character encodings

User agents must support the encodings defined in *Encoding*, including, but not limited to, [UTF-8](#), [ISO-8859-2](#), [ISO-8859-7](#), [ISO-8859-8](#), [windows-874](#), [windows-1250](#), [windows-1251](#), [windows-1252](#), [windows-1254](#), [windows-1255](#), [windows-1256](#), [windows-1257](#), [windows-1258](#), [GBK](#), [Big5](#), [ISO-2022-JP](#), [Shift JIS](#), [EUC-KR](#), [UTF-16BE](#), [UTF-16LE](#), [UTF-16BE/LE](#), and [x-user-defined](#). User agents must not support other encodings.

The above prohibits supporting, for example, CESU-8, UTF-7, BOCU-1, SCSU, EBCDIC, and UTF-32. This specification does not make any attempt to support prohibited encodings in its algorithms; support and use of prohibited encodings would thus lead to unexpected behavior.  
[\[CESU8\]](#) [\[UTF7\]](#) [\[BOCU1\]](#) [\[SCSU\]](#)

#### 13.2.3.4 Changing the encoding while parsing

When the parser requires the user agent to *change the encoding*, it must run the following steps. This might happen if the [encoding sniffing algorithm](#) described above failed to find a character encoding, or if it found a character encoding that was not the actual encoding of the file.

1. If the encoding that is already being used to interpret the input stream is [UTF-16BE/LE](#), then set the [confidence](#) to *certain* and return. The new encoding is ignored; if it was anything but the same encoding, then it would be clearly incorrect.
2. If the new encoding is [UTF-16BE/LE](#), then change it to [UTF-8](#).
3. If the new encoding is [x-user-defined](#), then change it to [windows-1252](#).
4. If the new encoding is identical or equivalent to the encoding that is already being used to interpret the input stream, then set the [confidence](#) to *certain* and return. This happens when the encoding information found in the file matches what the [encoding sniffing algorithm](#) determined to be the encoding, and in the second pass through the parser if the first pass found that the encoding sniffing algorithm described in the earlier section failed to find the right encoding.
5. If all the bytes up to the last byte converted by the current decoder have the same Unicode interpretations in both the current encoding and the new encoding, and if the user agent supports changing the converter on the fly, then the user agent may change to the new converter for the encoding on the fly. Set the [document's character encoding](#)

and the encoding used to convert the input stream to the new encoding, set the [confidence](#) to *certain*, and return.

6. Otherwise, [navigate](#) to the document again, with [historyHandling](#) set to "[replace](#)", and using the same [source browsing context](#), but this time skip the [encoding sniffing algorithm](#) and instead just set the encoding to the new encoding and the [confidence](#) to *certain*. Whenever possible, this should be done without actually contacting the network layer (the bytes should be re-parsed from memory), even if, e.g., the document is marked as not being cacheable. If this is not possible and contacting the network layer would involve repeating a request that uses a method other than 'GET', then instead set the [confidence](#) to *certain* and ignore the new encoding. The resource will be misinterpreted. User agents may notify the user of the situation, to aid in application development.

This algorithm is only invoked when a new encoding is found declared on a [meta](#) element.

#### 13.2.3.5 Preprocessing the input stream

The *input stream* consists of the characters pushed into it as the [input byte stream](#) is decoded or from the various APIs that directly manipulate the input stream.

Any occurrences of [surrogates](#) are [surrogate-in-input-stream parse errors](#). Any occurrences of [noncharacters](#) are [noncharacter-in-input-stream parse errors](#) and any occurrences of [controls](#) other than [ASCII whitespace](#) and U+0000 NULL characters are [control-character-in-input-stream parse errors](#).

The handling of U+0000 NULL characters varies based on where the characters are found and happens at the later stages of the parsing. They are either ignored or, for security reasons, replaced with a U+FFFD REPLACEMENT CHARACTER. This handling is, by necessity, spread across both the tokenization stage and the tree construction stage.

Before the [tokenization](#) stage, the input stream must be preprocessed by [normalizing newlines](#). Thus, newlines in HTML DOMs are represented by U+000A LF characters, and there are never any U+000D CR characters in the input to the [tokenization](#) stage.

The *next input character* is the first character in the [input stream](#) that has not yet been *consumed* or explicitly ignored by the requirements in this section. Initially, the [next input character](#) is the first character in the input. The *current input character* is the last character to have been *consumed*.

The *insertion point* is the position (just before a character or just before the end of the input stream) where content inserted using [document.write\(\)](#) is actually inserted. The insertion point is relative to the position of the character immediately after it, it is not an absolute offset into the input stream. Initially, the insertion point is undefined.

The "EOF" character in the tables below is a conceptual character representing the end of the [input stream](#). If the parser is a [script-created parser](#), then the end of the [input stream](#) is reached

when an *explicit "EOF" character* (inserted by the [document.close\(\)](#) method) is consumed. Otherwise, the "EOF" character is not a real character in the stream, but rather the lack of any further characters.

### 13.2.4 Parse state

#### 13.2.4.1 The insertion mode

The *insertion mode* is a state variable that controls the primary operation of the tree construction stage.

Initially, the [insertion mode](#) is "[initial](#)". It can change to "[before html](#)", "[before head](#)", "[in head](#)", "[in head noscript](#)", "[after head](#)", "[in body](#)", "[text](#)", "[in table](#)", "[in table text](#)", "[in caption](#)", "[in column group](#)", "[in table body](#)", "[in row](#)", "[in cell](#)", "[in select](#)", "[in select in table](#)", "[in template](#)", "[after body](#)", "[in frameset](#)", "[after frameset](#)", "[after after body](#)", and "[after after frameset](#)" during the course of the parsing, as described in the [tree construction](#) stage. The insertion mode affects how tokens are processed and whether CDATA sections are supported.

Several of these modes, namely "[in head](#)", "[in body](#)", "[in table](#)", and "[in select](#)", are special, in that the other modes defer to them at various times. When the algorithm below says that the user agent is to do something "*using the rules for the m insertion mode*", where m is one of these modes, the user agent must use the rules described under the m [insertion mode](#)'s section, but must leave the [insertion mode](#) unchanged unless the rules in m themselves switch the [insertion mode](#) to a new value.

When the insertion mode is switched to "[text](#)" or "[in table text](#)", the *original insertion mode* is also set. This is the insertion mode to which the tree construction stage will return.

Similarly, to parse nested [template](#) elements, a *stack of template insertion modes* is used. It is initially empty. The *current template insertion mode* is the insertion mode that was most recently added to the [stack of template insertion modes](#). The algorithms in the sections below will *push* insertion modes onto this stack, meaning that the specified insertion mode is to be added to the stack, and *pop* insertion modes from the stack, which means that the most recently added insertion mode must be removed from the stack.

---

When the steps below require the UA to *reset the insertion mode appropriately*, it means the UA must follow these steps:

1. Let *last* be false.
2. Let *node* be the last node in the [stack of open elements](#).
3. *Loop*: If *node* is the first node in the stack of open elements, then set *last* to true, and, if the parser was created as part of the [HTML fragment parsing algorithm \(fragment case\)](#), set *node* to the [context](#) element passed to that algorithm.

4. If *node* is a [select](#) element, run these substeps:
  1. If *last* is true, jump to the step below labeled *done*.
  2. Let *ancestor* be *node*.
  3. *Loop*: If *ancestor* is the first node in the [stack of open elements](#), jump to the step below labeled *done*.
  4. Let *ancestor* be the node before *ancestor* in the [stack of open elements](#).
  5. If *ancestor* is a [template](#) node, jump to the step below labeled *done*.
  6. If *ancestor* is a [table](#) node, switch the [insertion mode](#) to "[in select in table](#)" and return.
  7. Jump back to the step labeled *loop*.
  8. *Done*: Switch the [insertion mode](#) to "[in select](#)" and return.
5. If *node* is a [td](#) or [th](#) element and *last* is false, then switch the [insertion mode](#) to "[in cell](#)" and return.
6. If *node* is a [tr](#) element, then switch the [insertion mode](#) to "[in row](#)" and return.
7. If *node* is a [tbody](#), [thead](#), or [tfoot](#) element, then switch the [insertion mode](#) to "[in table body](#)" and return.
8. If *node* is a [caption](#) element, then switch the [insertion mode](#) to "[in caption](#)" and return.
9. If *node* is a [colgroup](#) element, then switch the [insertion mode](#) to "[in column group](#)" and return.
10. If *node* is a [table](#) element, then switch the [insertion mode](#) to "[in table](#)" and return.
11. If *node* is a [template](#) element, then switch the [insertion mode](#) to the [current template insertion mode](#) and return.
12. If *node* is a [head](#) element and *last* is false, then switch the [insertion mode](#) to "[in head](#)" and return.
13. If *node* is a [body](#) element, then switch the [insertion mode](#) to "[in body](#)" and return.
14. If *node* is a [frameset](#) element, then switch the [insertion mode](#) to "[in frameset](#)" and return. ([fragment case](#))
15. If *node* is an [html](#) element, run these substeps:

1. If the [head element pointer](#) is null, switch the [insertion mode](#) to "before head" and return. ([fragment case](#))
  2. Otherwise, the [head element pointer](#) is not null, switch the [insertion mode](#) to "after head" and return.
16. If *last* is true, then switch the [insertion mode](#) to "in body" and return. ([fragment case](#))
  17. Let *node* now be the node before *node* in the [stack of open elements](#).
  18. Return to the step labeled *loop*.

#### 13.2.4.2 The stack of open elements

Initially, the [stack of open elements](#) is empty. The stack grows downwards; the topmost node on the stack is the first one added to the stack, and the bottommost node of the stack is the most recently added node in the stack (notwithstanding when the stack is manipulated in a random access fashion as part of [the handling for misnested tags](#)).

The "before html" [insertion mode](#) creates the [html document element](#), which is then added to the stack.

In the [fragment case](#), the [stack of open elements](#) is initialized to contain an [html](#) element that is created as part of [that algorithm](#). (The [fragment case](#) skips the "before html" [insertion mode](#).)

The [html](#) node, however it is created, is the topmost node of the stack. It only gets popped off the stack when the parser [finishes](#).

The *current node* is the bottommost node in this [stack of open elements](#).

The *adjusted current node* is the [context](#) element if the parser was created as part of the [HTML fragment parsing algorithm](#) and the [stack of open elements](#) has only one element in it ([fragment case](#)); otherwise, the [adjusted current node](#) is the [current node](#).

Elements in the [stack of open elements](#) fall into the following categories:

#### *Special*

The following elements have varying levels of special parsing rules: HTML's [address](#), [applet](#), [area](#), [article](#), [aside](#), [base](#), [basefont](#), [bgsound](#), [blockquote](#), [body](#), [br](#), [button](#), [caption](#), [center](#), [col](#), [colgroup](#), [dd](#), [details](#), [dir](#), [div](#), [dl](#), [dt](#), [embed](#), [fieldset](#), [figcaption](#), [figure](#), [footer](#), [form](#), [frame](#), [frameset](#), [h1](#), [h2](#), [h3](#), [h4](#), [h5](#), [h6](#), [head](#), [header](#), [hgroup](#), [hr](#), [html](#), [iframe](#), [img](#), [input](#), [keygen](#), [li](#), [link](#), [listing](#), [main](#), [marquee](#), [menu](#), [meta](#), [nav](#), [noembed](#), [noframes](#), [noscript](#), [object](#), [ol](#), [p](#), [param](#), [plaintext](#), [pre](#), [script](#), [section](#), [select](#), [source](#), [style](#), [summary](#), [table](#), [tbody](#), [td](#), [template](#), [textarea](#), [tfoot](#), [th](#), [thead](#), [title](#), [tr](#), [track](#), [ul](#), [wbr](#), [xmp](#); [MathML mi](#), [MathML mo](#), [MathML mn](#), [MathML ms](#), [MathML mtext](#), and

[MathML annotation-xml](#); and [SVG foreignObject](#), [SVG desc](#), and [SVG title](#).

An **image** start tag token is handled by the tree builder, but it is not in this list because it is not an element; it gets turned into an [img](#) element.

### Formatting

The following HTML elements are those that end up in the [list of active formatting elements](#): [a](#), [b](#), [big](#), [code](#), [em](#), [font](#), [i](#), [nobr](#), [s](#), [small](#), [strike](#), [strong](#), [tt](#), and [u](#).

### Ordinary

All other elements found while parsing an HTML document.

Typically, the [special](#) elements have the start and end tag tokens handled specifically, while [ordinary](#) elements' tokens fall into "any other start tag" and "any other end tag" clauses, and some parts of the tree builder check if a particular element in the [stack of open elements](#) is in the [special](#) category. However, some elements (e.g., the [option](#) element) have their start or end tag tokens handled specifically, but are still not in the [special](#) category, so that they get the [ordinary](#) handling elsewhere.

The [stack of open elements](#) is said to *have an element target node in a specific scope* consisting of a list of element types *list* when the following algorithm terminates in a match state:

1. Initialize *node* to be the [current node](#) (the bottommost node of the stack).
2. If *node* is the target node, terminate in a match state.
3. Otherwise, if *node* is one of the element types in *list*, terminate in a failure state.
4. Otherwise, set *node* to the previous entry in the [stack of open elements](#) and return to step 2. (This will never fail, since the loop will always terminate in the previous step if the top of the stack — an [html](#) element — is reached.)

The [stack of open elements](#) is said to *have a particular element in scope* when it [has that element in the specific scope](#) consisting of the following element types:

- [applet](#)
- [caption](#)
- [html](#)
- [table](#)
- [td](#)
- [th](#)
- [marquee](#)
- [object](#)
- [template](#)
- [MathML mi](#)

- [MathML mo](#)
- [MathML mn](#)
- [MathML ms](#)
- [MathML mtext](#)
- [MathML annotation-xml](#)
- [SVG foreignObject](#)
- [SVG desc](#)
- [SVG title](#)

The [stack of open elements](#) is said to *have a particular element in list item scope* when it [has that element in the specific scope](#) consisting of the following element types:

- All the element types listed above for the [has an element in scope](#) algorithm.
- [ol](#) in the [HTML namespace](#)
- [ul](#) in the [HTML namespace](#)

The [stack of open elements](#) is said to *have a particular element in button scope* when it [has that element in the specific scope](#) consisting of the following element types:

- All the element types listed above for the [has an element in scope](#) algorithm.
- [button](#) in the [HTML namespace](#)

The [stack of open elements](#) is said to *have a particular element in table scope* when it [has that element in the specific scope](#) consisting of the following element types:

- [html](#) in the [HTML namespace](#)
- [table](#) in the [HTML namespace](#)
- [template](#) in the [HTML namespace](#)

The [stack of open elements](#) is said to *have a particular element in select scope* when it [has that element in the specific scope](#) consisting of all element types except the following:

- [optgroup](#) in the [HTML namespace](#)
- [option](#) in the [HTML namespace](#)

Nothing happens if at any time any of the elements in the [stack of open elements](#) are moved to a new location in, or removed from, the [Document](#) tree. In particular, the stack is not changed in this situation. This can cause, amongst other strange effects, content to be appended to nodes that are no longer in the DOM.

In some cases (namely, when [closing misnested formatting elements](#)), the stack is manipulated in a random-access fashion.

#### 13.2.4.3 The list of active formatting elements

Initially, the *list of active formatting elements* is empty. It is used to handle mis-nested [formatting element tags](#).

The list contains elements in the [formatting](#) category, and [markers](#). The *markers* are inserted when entering [applet](#), [object](#), [marquee](#), [template](#), [td](#), [th](#), and [caption](#) elements, and are used to prevent formatting from "leaking" into [applet](#), [object](#), [marquee](#), [template](#), [td](#), [th](#), and [caption](#) elements.

In addition, each element in the [list of active formatting elements](#) is associated with the token for which it was created, so that further elements can be created for that token if necessary.

When the steps below require the UA to *push onto the list of active formatting elements* an element *element*, the UA must perform the following steps:

1. If there are already three elements in the [list of active formatting elements](#) after the last [marker](#), if any, or anywhere in the list if there are no [markers](#), that have the same tag name, namespace, and attributes as *element*, then remove the earliest such element from the [list of active formatting elements](#). For these purposes, the attributes must be compared as they were when the elements were created by the parser; two elements have the same attributes if all their parsed attributes can be paired such that the two attributes in each pair have identical names, namespaces, and values (the order of the attributes does not matter).

This is the Noah's Ark clause. But with three per family instead of two.

2. Add *element* to the [list of active formatting elements](#).

When the steps below require the UA to *reconstruct the active formatting elements*, the UA must perform the following steps:

1. If there are no entries in the [list of active formatting elements](#), then there is nothing to reconstruct; stop this algorithm.
2. If the last (most recently added) entry in the [list of active formatting elements](#) is a [marker](#), or if it is an element that is in the [stack of open elements](#), then there is nothing to reconstruct; stop this algorithm.
3. Let *entry* be the last (most recently added) element in the [list of active formatting elements](#).
4. *Rewind*: If there are no entries before *entry* in the [list of active formatting elements](#), then jump to the step labeled *create*.
5. Let *entry* be the entry one earlier than *entry* in the [list of active formatting elements](#).
6. If *entry* is neither a [marker](#) nor an element that is also in the [stack of open elements](#), go to the step labeled *rewind*.
7. *Advance*: Let *entry* be the element one later than *entry* in the [list of active formatting elements](#).

8. Create: [Insert an HTML element](#) for the token for which the element *entry* was created, to obtain *new element*.
9. Replace the entry for *entry* in the list with an entry for *new element*.
10. If the entry for *new element* in the [list of active formatting elements](#) is not the last entry in the list, return to the step labeled *advance*.

This has the effect of reopening all the formatting elements that were opened in the current body, cell, or caption (whichever is youngest) that haven't been explicitly closed.

The way this specification is written, the [list of active formatting elements](#) always consists of elements in chronological order with the least recently added element first and the most recently added element last (except for while steps 7 to 10 of the above algorithm are being executed, of course).

When the steps below require the UA to *clear the list of active formatting elements up to the last marker*, the UA must perform the following steps:

1. Let *entry* be the last (most recently added) entry in the [list of active formatting elements](#).
2. Remove *entry* from the [list of active formatting elements](#).
3. If *entry* was a [marker](#), then stop the algorithm at this point. The list has been cleared up to the last [marker](#).
4. Go to step 1.

#### 13.2.4.4 The element pointers

Initially, the [head element pointer](#) and the [form element pointer](#) are both null.

Once a [head](#) element has been parsed (whether implicitly or explicitly) the [head element pointer](#) gets set to point to this node.

The [form element pointer](#) points to the last [form](#) element that was opened and whose end tag has not yet been seen. It is used to make form controls associate with forms in the face of dramatically bad markup, for historical reasons. It is ignored inside [template](#) elements.

#### 13.2.4.5 Other parsing state flags

The [scripting flag](#) is set to "enabled" if [scripting was enabled](#) for the [Document](#) with which the parser is associated when the parser was created, and "disabled" otherwise.

The [scripting flag](#) can be enabled even when the parser was created as part of the [HTML fragment parsing algorithm](#), even though [script](#) elements don't execute in that case.

The `frameset-ok` flag is set to "ok" when the parser is created. It is set to "not ok" after certain tokens are seen.

### 13.2.5 Tokenization

Implementations must act as if they used the following state machine to tokenize HTML. The state machine must start in the [data state](#). Most states consume a single character, which may have various side-effects, and either switches the state machine to a new state to [reconsume the current input character](#), or switches it to a new state to consume the [next character](#), or stays in the same state to consume the next character. Some states have more complicated behavior and can consume several characters before switching to another state. In some cases, the tokenizer state is also changed by the tree construction stage.

When a state says to *reconsume* a matched character in a specified state, that means to switch to that state, but when it attempts to consume the [next input character](#), provide it with the [current input character](#) instead.

The exact behavior of certain states depends on the [insertion mode](#) and the [stack of open elements](#). Certain states also use a *temporary buffer* to track progress, and the [character reference state](#) uses a *return state* to return to the state it was invoked from.

The output of the tokenization step is a series of zero or more of the following tokens: DOCTYPE, start tag, end tag, comment, character, end-of-file. DOCTYPE tokens have a name, a public identifier, a system identifier, and a *force-quirks flag*. When a DOCTYPE token is created, its name, public identifier, and system identifier must be marked as missing (which is a distinct state from the empty string), and the [force-quirks flag](#) must be set to *off* (its other state is *on*). Start and end tag tokens have a tag name, a *self-closing flag*, and a list of attributes, each of which has a name and a value. When a start or end tag token is created, its [self-closing flag](#) must be unset (its other state is that it be set), and its attributes list must be empty. Comment and character tokens have data.

When a token is emitted, it must immediately be handled by the [tree construction](#) stage. The tree construction stage can affect the state of the tokenization stage, and can insert additional characters into the stream. (For example, the [script](#) element can result in scripts executing and using the [dynamic markup insertion](#) APIs to insert characters into the stream being tokenized.)

Creating a token and emitting it are distinct actions. It is possible for a token to be created but implicitly abandoned (never emitted), e.g. if the file ends unexpectedly while processing the characters that are being parsed into a start tag token.

When a start tag token is emitted with its [self-closing flag](#) set, if the flag is not acknowledged when it is processed by the tree construction stage, that is a [non-void-html-element-start-tag-with-trailing-solidus parse error](#).

When an end tag token is emitted with attributes, that is an [end-tag-with-attributes parse error](#).

When an end tag token is emitted with its [self-closing flag](#) set, that is an [end-tag-with-trailing-solidus parse error](#).

An *appropriate end tag token* is an end tag token whose tag name matches the tag name of the last start tag to have been emitted from this tokenizer, if any. If no start tag has been emitted from this tokenizer, then no end tag token is appropriate.

A [character reference](#) is said to be *consumed as part of an attribute* if the [return state](#) is either [attribute value \(double-quoted\) state](#), [attribute value \(single-quoted\) state](#) or [attribute value \(unquoted\) state](#).

When a state says to *flush code points consumed as a character reference*, it means that for each [code point](#) in the [temporary buffer](#) (in the order they were added to the buffer) user agent must append the code point from the buffer to the current attribute's value if the character reference was [consumed as part of an attribute](#), or emit the code point as a character token otherwise.

Before each step of the tokenizer, the user agent must first check the [parser pause flag](#). If it is true, then the tokenizer must abort the processing of any nested invocations of the tokenizer, yielding control back to the caller.

The tokenizer state machine consists of the states defined in the following subsections.

#### 13.2.5.1 *Data state*

Consume the [next input character](#):

U+0026 AMPERSAND (&)

Set the [return state](#) to the [data state](#). Switch to the [character reference state](#).

U+003C LESS-THAN SIGN (<)

Switch to the [tag open state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Emit the [current input character](#) as a character token.

EOF

Emit an end-of-file token.

Anything else

Emit the [current input character](#) as a character token.

#### 13.2.5.2 *RCDATA state*

Consume the [next input character](#):

**U+0026 AMPERSAND (&)**

Set the [return state](#) to the [RCDATA state](#). Switch to the [character reference state](#).

**U+003C LESS-THAN SIGN (<)**

Switch to the [RCDATA less-than sign state](#).

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

**EOF**

Emit an end-of-file token.

**Anything else**

Emit the [current input character](#) as a character token.

#### 13.2.5.3 *RAWTEXT state*

Consume the [next input character](#):

**U+003C LESS-THAN SIGN (<)**

Switch to the [RAWTEXT less-than sign state](#).

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

**EOF**

Emit an end-of-file token.

**Anything else**

Emit the [current input character](#) as a character token.

#### 13.2.5.4 *Script data state*

Consume the [next input character](#):

**U+003C LESS-THAN SIGN (<)**

Switch to the [script data less-than sign state](#).

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

**EOF**

Emit an end-of-file token.

**Anything else**

Emit the [current input character](#) as a character token.

### 13.2.5.5 PLAINTEXT state

Consume the [next input character](#):

U+0000 NULL

This is an [unexpected-null-character parse error](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

EOF

Emit an end-of-file token.

Anything else

Emit the [current input character](#) as a character token.

### 13.2.5.6 Tag open state

Consume the [next input character](#):

U+0021 EXCLAMATION MARK (!)

Switch to the [markup declaration open state](#).

U+002F SOLIDUS (/)

Switch to the [end tag open state](#).

[ASCII alpha](#)

Create a new start tag token, set its tag name to the empty string. [Reconsume](#) in the [tag name state](#).

U+003F QUESTION MARK (?)

This is an [unexpected-question-mark-instead-of-tag-name parse error](#). Create a comment token whose data is the empty string. [Reconsume](#) in the [bogus comment state](#).

EOF

This is an [eof-before-tag-name parse error](#). Emit a U+003C LESS-THAN SIGN character token and an end-of-file token.

Anything else

This is an [invalid-first-character-of-tag-name parse error](#). Emit a U+003C LESS-THAN SIGN character token. [Reconsume](#) in the [data state](#).

### 13.2.5.7 End tag open state

Consume the [next input character](#):

[ASCII alpha](#)

Create a new end tag token, set its tag name to the empty string. [Reconsume](#) in the [tag name state](#).

U+003E GREATER-THAN SIGN (>)

This is a [missing-end-tag-name parse error](#). Switch to the [data state](#).

EOF

This is an [eof-before-tag-name parse error](#). Emit a U+003C LESS-THAN SIGN character token, a U+002F SOLIDUS character token and an end-of-file token.

Anything else

This is an [invalid-first-character-of-tag-name parse error](#). Create a comment token whose data is the empty string. [Reconsume](#) in the [bogus comment state](#).

#### 13.2.5.8 Tag name state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [before attribute name state](#).

U+002F SOLIDUS (/)

Switch to the [self-closing start tag state](#).

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current tag token.

[ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the current tag token's tag name.

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current tag token's tag name.

EOF

This is an [eof-in-tag parse error](#). Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current tag token's tag name.

#### 13.2.5.9 RCDATA less-than sign state

Consume the [next input character](#):

U+002F SOLIDUS (/)

Set the [temporary buffer](#) to the empty string. Switch to the [RCDATA end tag open state](#).

## Anything else

Emit a U+003C LESS-THAN SIGN character token. [Reconsume](#) in the [RCDATA state](#).

### 13.2.5.10 RCDATA end tag open state

Consume the [next input character](#):

#### [ASCII alpha](#)

Create a new end tag token, set its tag name to the empty string. [Reconsume](#) in the [RCDATA end tag name state](#).

## Anything else

Emit a U+003C LESS-THAN SIGN character token and a U+002F SOLIDUS character token. [Reconsume](#) in the [RCDATA state](#).

### 13.2.5.11 RCDATA end tag name state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

If the current end tag token is an [appropriate end tag token](#), then switch to the [before attribute name state](#). Otherwise, treat it as per the "anything else" entry below.

U+002F SOLIDUS (/)

If the current end tag token is an [appropriate end tag token](#), then switch to the [self-closing start tag state](#). Otherwise, treat it as per the "anything else" entry below.

U+003E GREATER-THAN SIGN (>)

If the current end tag token is an [appropriate end tag token](#), then switch to the [data state](#) and emit the current tag token. Otherwise, treat it as per the "anything else" entry below.

#### [ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the current tag token's tag name. Append the [current input character](#) to the [temporary buffer](#).

#### [ASCII lower alpha](#)

Append the [current input character](#) to the current tag token's tag name. Append the [current input character](#) to the [temporary buffer](#).

## Anything else

Emit a U+003C LESS-THAN SIGN character token, a U+002F SOLIDUS character token, and a character token for each of the characters in the [temporary buffer](#) (in the order they were added to the buffer). [Reconsume](#) in the [RCDATA state](#).

### 13.2.5.12 RAWTEXT less-than sign state

Consume the [next input character](#):

U+002F SOLIDUS (/)

Set the [temporary buffer](#) to the empty string. Switch to the [RAWTEXT end tag open state](#).

Anything else

Emit a U+003C LESS-THAN SIGN character token. [Reconsume](#) in the [RAWTEXT state](#).

### 13.2.5.13 RAWTEXT end tag open state

Consume the [next input character](#):

[ASCII alpha](#)

Create a new end tag token, set its tag name to the empty string. [Reconsume](#) in the [RAWTEXT end tag name state](#).

Anything else

Emit a U+003C LESS-THAN SIGN character token and a U+002F SOLIDUS character token. [Reconsume](#) in the [RAWTEXT state](#).

### 13.2.5.14 RAWTEXT end tag name state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

If the current end tag token is an [appropriate end tag token](#), then switch to the [before attribute name state](#). Otherwise, treat it as per the "anything else" entry below.

U+002F SOLIDUS (/)

If the current end tag token is an [appropriate end tag token](#), then switch to the [self-closing start tag state](#). Otherwise, treat it as per the "anything else" entry below.

U+003E GREATER-THAN SIGN (>)

If the current end tag token is an [appropriate end tag token](#), then switch to the [data state](#) and emit the current tag token. Otherwise, treat it as per the "anything else" entry below.

[ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the current tag token's tag name. Append the [current input character](#) to the [temporary buffer](#).

[ASCII lower alpha](#)

Append the [current input character](#) to the current tag token's tag name. Append the

[current input character](#) to the [temporary buffer](#).

#### Anything else

Emit a U+003C LESS-THAN SIGN character token, a U+002F SOLIDUS character token, and a character token for each of the characters in the [temporary buffer](#) (in the order they were added to the buffer). [Reconsume](#) in the [RAWTEXT state](#).

#### 13.2.5.15 *Script data less-than sign state*

Consume the [next input character](#):

U+002F SOLIDUS (/)

Set the [temporary buffer](#) to the empty string. Switch to the [script data end tag open state](#).

U+0021 EXCLAMATION MARK (!)

Switch to the [script data escape start state](#). Emit a U+003C LESS-THAN SIGN character token and a U+0021 EXCLAMATION MARK character token.

#### Anything else

Emit a U+003C LESS-THAN SIGN character token. [Reconsume](#) in the [script data state](#).

#### 13.2.5.16 *Script data end tag open state*

Consume the [next input character](#):

[ASCII alpha](#)

Create a new end tag token, set its tag name to the empty string. [Reconsume](#) in the [script data end tag name state](#).

#### Anything else

Emit a U+003C LESS-THAN SIGN character token and a U+002F SOLIDUS character token. [Reconsume](#) in the [script data state](#).

#### 13.2.5.17 *Script data end tag name state*

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

If the current end tag token is an [appropriate end tag token](#), then switch to the [before attribute name state](#). Otherwise, treat it as per the "anything else" entry below.

U+002F SOLIDUS (/)

If the current end tag token is an [appropriate end tag token](#), then switch to the [self-closing start tag state](#). Otherwise, treat it as per the "anything else" entry below.

## U+003E GREATER-THAN SIGN (>)

If the current end tag token is an [appropriate end tag token](#), then switch to the [data state](#) and emit the current tag token. Otherwise, treat it as per the "anything else" entry below.

### [ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the current tag token's tag name. Append the [current input character](#) to the [temporary buffer](#).

### [ASCII lower alpha](#)

Append the [current input character](#) to the current tag token's tag name. Append the [current input character](#) to the [temporary buffer](#).

### Anything else

Emit a U+003C LESS-THAN SIGN character token, a U+002F SOLIDUS character token, and a character token for each of the characters in the [temporary buffer](#) (in the order they were added to the buffer). [Reconsume](#) in the [script data state](#).

#### 13.2.5.18 *Script data escape start state*

Consume the [next input character](#):

### U+002D HYPHEN-MINUS (-)

Switch to the [script data escape start dash state](#). Emit a U+002D HYPHEN-MINUS character token.

### Anything else

[Reconsume](#) in the [script data state](#).

#### 13.2.5.19 *Script data escape start dash state*

Consume the [next input character](#):

### U+002D HYPHEN-MINUS (-)

Switch to the [script data escaped dash dash state](#). Emit a U+002D HYPHEN-MINUS character token.

### Anything else

[Reconsume](#) in the [script data state](#).

#### 13.2.5.20 *Script data escaped state*

Consume the [next input character](#):

### U+002D HYPHEN-MINUS (-)

Switch to the [script data escaped dash state](#). Emit a U+002D HYPHEN-MINUS character token.

**U+003C LESS-THAN SIGN (<)**

Switch to the [script data escaped less-than sign state](#).

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

**EOF**

This is an [eof-in-script-html-comment-like-text parse error](#). Emit an end-of-file token.

**Anything else**

Emit the [current input character](#) as a character token.

#### 13.2.5.21 *Script data escaped dash state*

Consume the [next input character](#):

**U+002D HYPHEN-MINUS (-)**

Switch to the [script data escaped dash dash state](#). Emit a U+002D HYPHEN-MINUS character token.

**U+003C LESS-THAN SIGN (<)**

Switch to the [script data escaped less-than sign state](#).

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Switch to the [script data escaped state](#).  
Emit a U+FFFD REPLACEMENT CHARACTER character token.

**EOF**

This is an [eof-in-script-html-comment-like-text parse error](#). Emit an end-of-file token.

**Anything else**

Switch to the [script data escaped state](#). Emit the [current input character](#) as a character token.

#### 13.2.5.22 *Script data escaped dash dash state*

Consume the [next input character](#):

**U+002D HYPHEN-MINUS (-)**

Emit a U+002D HYPHEN-MINUS character token.

**U+003C LESS-THAN SIGN (<)**

Switch to the [script data escaped less-than sign state](#).

**U+003E GREATER-THAN SIGN (>)**

Switch to the [script data state](#). Emit a U+003E GREATER-THAN SIGN character token.

U+0000 NULL

This is an [unexpected-null-character parse error](#). Switch to the [script data escaped state](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

EOF

This is an [eof-in-script-html-comment-like-text parse error](#). Emit an end-of-file token.

Anything else

Switch to the [script data escaped state](#). Emit the [current input character](#) as a character token.

#### 13.2.5.23 Script data escaped less-than sign state

Consume the [next input character](#):

U+002F SOLIDUS (/)

Set the [temporary buffer](#) to the empty string. Switch to the [script data escaped end tag open state](#).

[ASCII alpha](#)

Set the [temporary buffer](#) to the empty string. Emit a U+003C LESS-THAN SIGN character token. [Reconsume](#) in the [script data double escape start state](#).

Anything else

Emit a U+003C LESS-THAN SIGN character token. [Reconsume](#) in the [script data escaped state](#).

#### 13.2.5.24 Script data escaped end tag open state

Consume the [next input character](#):

[ASCII alpha](#)

Create a new end tag token, set its tag name to the empty string. [Reconsume](#) in the [script data escaped end tag name state](#).

Anything else

Emit a U+003C LESS-THAN SIGN character token and a U+002F SOLIDUS character token. [Reconsume](#) in the [script data escaped state](#).

#### 13.2.5.25 Script data escaped end tag name state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

If the current end tag token is an [appropriate end tag token](#), then switch to the [before](#)

[attribute name state](#). Otherwise, treat it as per the "anything else" entry below.

#### U+002F SOLIDUS (/)

If the current end tag token is an [appropriate end tag token](#), then switch to the [self-closing start tag state](#). Otherwise, treat it as per the "anything else" entry below.

#### U+003E GREATER-THAN SIGN (>)

If the current end tag token is an [appropriate end tag token](#), then switch to the [data state](#) and emit the current tag token. Otherwise, treat it as per the "anything else" entry below.

#### [ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the current tag token's tag name. Append the [current input character](#) to the [temporary buffer](#).

#### [ASCII lower alpha](#)

Append the [current input character](#) to the current tag token's tag name. Append the [current input character](#) to the [temporary buffer](#).

#### Anything else

Emit a U+003C LESS-THAN SIGN character token, a U+002F SOLIDUS character token, and a character token for each of the characters in the [temporary buffer](#) (in the order they were added to the buffer). [Reconsume](#) in the [script data escaped state](#).

### 13.2.5.26 Script data double escape start state

Consume the [next input character](#):

#### U+0009 CHARACTER TABULATION (tab)

#### U+000A LINE FEED (LF)

#### U+000C FORM FEED (FF)

#### U+0020 SPACE

#### U+002F SOLIDUS (/)

#### U+003E GREATER-THAN SIGN (>)

If the [temporary buffer](#) is the string "**script**", then switch to the [script data double escaped state](#). Otherwise, switch to the [script data escaped state](#). Emit the [current input character](#) as a character token.

#### [ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the [temporary buffer](#). Emit the [current input character](#) as a character token.

#### [ASCII lower alpha](#)

Append the [current input character](#) to the [temporary buffer](#). Emit the [current input character](#) as a character token.

#### Anything else

[Reconsume](#) in the [script data escaped state](#).

### 13.2.5.27 Script data double escaped state

Consume the [next input character](#):

**U+002D HYPHEN-MINUS (-)**

Switch to the [script data double escaped dash state](#). Emit a U+002D HYPHEN-MINUS character token.

**U+003C LESS-THAN SIGN (<)**

Switch to the [script data double escaped less-than sign state](#). Emit a U+003C LESS-THAN SIGN character token.

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

**EOF**

This is an [eof-in-script-html-comment-like-text parse error](#). Emit an end-of-file token.

**Anything else**

Emit the [current input character](#) as a character token.

### 13.2.5.28 Script data double escaped dash state

Consume the [next input character](#):

**U+002D HYPHEN-MINUS (-)**

Switch to the [script data double escaped dash dash state](#). Emit a U+002D HYPHEN-MINUS character token.

**U+003C LESS-THAN SIGN (<)**

Switch to the [script data double escaped less-than sign state](#). Emit a U+003C LESS-THAN SIGN character token.

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Switch to the [script data double escaped state](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

**EOF**

This is an [eof-in-script-html-comment-like-text parse error](#). Emit an end-of-file token.

**Anything else**

Switch to the [script data double escaped state](#). Emit the [current input character](#) as a character token.

### 13.2.5.29 Script data double escaped dash dash state

Consume the [next input character](#):

U+002D HYPHEN-MINUS (-)

Emit a U+002D HYPHEN-MINUS character token.

U+003C LESS-THAN SIGN (<)

Switch to the [script data double escaped less-than sign state](#). Emit a U+003C LESS-THAN SIGN character token.

U+003E GREATER-THAN SIGN (>)

Switch to the [script data state](#). Emit a U+003E GREATER-THAN SIGN character token.

U+0000 NULL

This is an [unexpected-null-character parse error](#). Switch to the [script data double escaped state](#). Emit a U+FFFD REPLACEMENT CHARACTER character token.

EOF

This is an [eof-in-script-html-comment-like-text parse error](#). Emit an end-of-file token.

Anything else

Switch to the [script data double escaped state](#). Emit the [current input character](#) as a character token.

#### 13.2.5.30 Script data double escaped less-than sign state

Consume the [next input character](#):

U+002F SOLIDUS (/)

Set the [temporary buffer](#) to the empty string. Switch to the [script data double escape end state](#). Emit a U+002F SOLIDUS character token.

Anything else

[Reconsume](#) in the [script data double escaped state](#).

#### 13.2.5.31 Script data double escape end state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

U+002F SOLIDUS (/)

U+003E GREATER-THAN SIGN (>)

If the [temporary buffer](#) is the string "script", then switch to the [script data escaped state](#).

Otherwise, switch to the [script data double escaped state](#). Emit the [current input character](#) as a character token.

[ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's

code point) to the *temporary buffer*. Emit the *current input character* as a character token.

#### ASCII lower alpha

Append the *current input character* to the *temporary buffer*. Emit the *current input character* as a character token.

#### Anything else

Reconsume in the *script data double escaped state*.

##### 13.2.5.32 *Before attribute name state*

Consume the *next input character*:

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

U+002F SOLIDUS (/)

U+003E GREATER-THAN SIGN (>)

EOF

Reconsume in the *after attribute name state*.

U+003D EQUALS SIGN (=)

This is an unexpected-equals-sign-before-attribute-name parse error. Start a new attribute in the current tag token. Set that attribute's name to the *current input character*, and its value to the empty string. Switch to the *attribute name state*.

#### Anything else

Start a new attribute in the current tag token. Set that attribute name and value to the empty string. Reconsume in the *attribute name state*.

##### 13.2.5.33 *Attribute name state*

Consume the *next input character*:

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

U+002F SOLIDUS (/)

U+003E GREATER-THAN SIGN (>)

EOF

Reconsume in the *after attribute name state*.

U+003D EQUALS SIGN (=)

Switch to the *before attribute value state*.

## [ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the current attribute's name.

## [U+0000 NULL](#)

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current attribute's name.

## [U+0022 QUOTATION MARK \(""\)](#)

## [U+0027 APOSTROPHE \(''\)](#)

## [U+003C LESS-THAN SIGN \(<\)](#)

This is an [unexpected-character-in-attribute-name parse error](#). Treat it as per the "anything else" entry below.

## [Anything else](#)

Append the [current input character](#) to the current attribute's name.

When the user agent leaves the attribute name state (and before emitting the tag token, if appropriate), the complete attribute's name must be compared to the other attributes on the same token; if there is already an attribute on the token with the exact same name, then this is a [duplicate-attribute parse error](#) and the new attribute must be removed from the token.

If an attribute is so removed from a token, it, and the value that gets associated with it, if any, are never subsequently used by the parser, and are therefore effectively discarded. Removing the attribute in this way does not change its status as the "current attribute" for the purposes of the tokenizer, however.

### [13.2.5.34 After attribute name state](#)

Consume the [next input character](#):

## [U+0009 CHARACTER TABULATION \(tab\)](#)

## [U+000A LINE FEED \(LF\)](#)

## [U+000C FORM FEED \(FF\)](#)

## [U+0020 SPACE](#)

Ignore the character.

## [U+002F SOLIDUS \(/\)](#)

Switch to the [self-closing start tag state](#).

## [U+003D EQUALS SIGN \(=\)](#)

Switch to the [before attribute value state](#).

## [U+003E GREATER-THAN SIGN \(>\)](#)

Switch to the [data state](#). Emit the current tag token.

## [EOF](#)

This is an [eof-in-tag parse error](#). Emit an end-of-file token.

## Anything else

Start a new attribute in the current tag token. Set that attribute name and value to the empty string. [Reconsume](#) in the [attribute name state](#).

### 13.2.5.35 Before attribute value state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

U+0022 QUOTATION MARK ("")

Switch to the [attribute value \(double-quoted\) state](#).

U+0027 APOSTROPHE ('')

Switch to the [attribute value \(single-quoted\) state](#).

U+003E GREATER-THAN SIGN (>)

This is a [missing-attribute-value parse error](#). Switch to the [data state](#). Emit the current tag token.

## Anything else

[Reconsume](#) in the [attribute value \(unquoted\) state](#).

### 13.2.5.36 Attribute value (double-quoted) state

Consume the [next input character](#):

U+0022 QUOTATION MARK ("")

Switch to the [after attribute value \(quoted\) state](#).

U+0026 AMPERSAND (&)

Set the [return state](#) to the [attribute value \(double-quoted\) state](#). Switch to the [character reference state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFF4 REPLACEMENT CHARACTER character to the current attribute's value.

EOF

This is an [eof-in-tag parse error](#). Emit an end-of-file token.

## Anything else

Append the [current input character](#) to the current attribute's value.

#### 13.2.5.37 Attribute value (single-quoted) state

Consume the [next input character](#):

U+0027 APOSTROPHE (')

Switch to the [after attribute value \(quoted\) state](#).

U+0026 AMPERSAND (&)

Set the [return state](#) to the [attribute value \(single-quoted\) state](#). Switch to the [character reference state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current attribute's value.

EOF

This is an [eof-in-tag parse error](#). Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current attribute's value.

#### 13.2.5.38 Attribute value (unquoted) state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [before attribute name state](#).

U+0026 AMPERSAND (&)

Set the [return state](#) to the [attribute value \(unquoted\) state](#). Switch to the [character reference state](#).

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current tag token.

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current attribute's value.

U+0022 QUOTATION MARK (")

U+0027 APOSTROPHE (')

U+003C LESS-THAN SIGN (<)

U+003D EQUALS SIGN (=)

U+0060 GRAVE ACCENT (`)

This is an [unexpected-character-in-unquoted-attribute-value parse error](#). Treat it as per

the "anything else" entry below.

EOF

This is an [eof-in-tag parse error](#). Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current attribute's value.

#### 13.2.5.39 After attribute value (quoted) state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [before attribute name state](#).

U+002F SOLIDUS (/)

Switch to the [self-closing start tag state](#).

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current tag token.

EOF

This is an [eof-in-tag parse error](#). Emit an end-of-file token.

Anything else

This is a [missing-whitespace-between-attributes parse error](#). [Reconsume](#) in the [before attribute name state](#).

#### 13.2.5.40 Self-closing start tag state

Consume the [next input character](#):

U+003E GREATER-THAN SIGN (>)

Set the [self-closing flag](#) of the current tag token. Switch to the [data state](#). Emit the current tag token.

EOF

This is an [eof-in-tag parse error](#). Emit an end-of-file token.

Anything else

This is an [unexpected-solidus-in-tag parse error](#). [Reconsume](#) in the [before attribute name state](#).

#### 13.2.5.41 *Bogus comment state*

Consume the [next input character](#):

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current comment token.

EOF

Emit the comment. Emit an end-of-file token.

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the comment token's data.

Anything else

Append the [current input character](#) to the comment token's data.

#### 13.2.5.42 *Markup declaration open state*

If the next few characters are:

Two U+002D HYPHEN-MINUS characters (-)

Consume those two characters, create a comment token whose data is the empty string, and switch to the [comment start state](#).

[ASCII case-insensitive](#) match for the word "DOCTYPE"

Consume those characters and switch to the [DOCTYPE state](#).

The string "[CDATA[" (the five uppercase letters "CDATA" with a U+005B LEFT SQUARE BRACKET character before and after)

Consume those characters. If there is an [adjusted current node](#) and it is not an element in the [HTML namespace](#), then switch to the [CDATA section state](#). Otherwise, this is a [cdata-in-html-content parse error](#). Create a comment token whose data is the "[CDATA[" string. Switch to the [bogus comment state](#).

Anything else

This is an [incorrectly-opened-comment parse error](#). Create a comment token whose data is the empty string. Switch to the [bogus comment state](#) (don't consume anything in the current state).

#### 13.2.5.43 *Comment start state*

Consume the [next input character](#):

U+002D HYPHEN-MINUS (-)

Switch to the [comment start dash state](#).

**U+003E GREATER-THAN SIGN (>)**

This is an [abrupt-closing-of-empty-comment parse error](#). Switch to the [data state](#). Emit the current comment token.

**Anything else**

[Reconsume](#) in the [comment state](#).

#### 13.2.5.44 *Comment start dash state*

Consume the [next input character](#):

**U+002D HYPHEN-MINUS (-)**

Switch to the [comment end state](#).

**U+003E GREATER-THAN SIGN (>)**

This is an [abrupt-closing-of-empty-comment parse error](#). Switch to the [data state](#). Emit the current comment token.

**EOF**

This is an [eof-in-comment parse error](#). Emit the current comment token. Emit an end-of-file token.

**Anything else**

Append a U+002D HYPHEN-MINUS character (-) to the comment token's data.

[Reconsume](#) in the [comment state](#).

#### 13.2.5.45 *Comment state*

Consume the [next input character](#):

**U+003C LESS-THAN SIGN (<)**

Append the [current input character](#) to the comment token's data. Switch to the [comment less-than sign state](#).

**U+002D HYPHEN-MINUS (-)**

Switch to the [comment end dash state](#).

**U+0000 NULL**

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the comment token's data.

**EOF**

This is an [eof-in-comment parse error](#). Emit the current comment token. Emit an end-of-file token.

**Anything else**

Append the [current input character](#) to the comment token's data.

#### 13.2.5.46 Comment less-than sign state

Consume the [next input character](#):

U+0021 EXCLAMATION MARK (!)

Append the [current input character](#) to the comment token's data. Switch to the [comment less-than sign bang state](#).

U+003C LESS-THAN SIGN (<)

Append the [current input character](#) to the comment token's data.

Anything else

[Reconsume](#) in the [comment state](#).

#### 13.2.5.47 Comment less-than sign bang state

Consume the [next input character](#):

U+002D HYPHEN-MINUS (-)

Switch to the [comment less-than sign bang dash state](#).

Anything else

[Reconsume](#) in the [comment state](#).

#### 13.2.5.48 Comment less-than sign bang dash state

Consume the [next input character](#):

U+002D HYPHEN-MINUS (-)

Switch to the [comment less-than sign bang dash dash state](#).

Anything else

[Reconsume](#) in the [comment end dash state](#).

#### 13.2.5.49 Comment less-than sign bang dash dash state

Consume the [next input character](#):

U+003E GREATER-THAN SIGN (>)

EOF

[Reconsume](#) in the [comment end state](#).

Anything else

This is a [nested-comment parse error](#). [Reconsume](#) in the [comment end state](#).

#### 13.2.5.50 Comment end dash state

Consume the [next input character](#):

U+002D HYPHEN-MINUS (-)

Switch to the [comment end state](#).

EOF

This is an [eof-in-comment parse error](#). Emit the current comment token. Emit an end-of-file token.

Anything else

Append a U+002D HYPHEN-MINUS character (-) to the comment token's data.  
[Reconsume](#) in the [comment state](#).

#### 13.2.5.51 *Comment end state*

Consume the [next input character](#):

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current comment token.

U+0021 EXCLAMATION MARK (!)

Switch to the [comment end bang state](#).

U+002D HYPHEN-MINUS (-)

Append a U+002D HYPHEN-MINUS character (-) to the comment token's data.

EOF

This is an [eof-in-comment parse error](#). Emit the current comment token. Emit an end-of-file token.

Anything else

Append two U+002D HYPHEN-MINUS characters (-) to the comment token's data.  
[Reconsume](#) in the [comment state](#).

#### 13.2.5.52 *Comment end bang state*

Consume the [next input character](#):

U+002D HYPHEN-MINUS (-)

Append two U+002D HYPHEN-MINUS characters (-) and a U+0021 EXCLAMATION MARK character (!) to the comment token's data. Switch to the [comment end dash state](#).

U+003E GREATER-THAN SIGN (>)

This is an [incorrectly-closed-comment parse error](#). Switch to the [data state](#). Emit the current comment token.

EOF

This is an [eof-in-comment parse error](#). Emit the current comment token. Emit an end-of-file token.

## Anything else

Append two U+002D HYPHEN-MINUS characters (-) and a U+0021 EXCLAMATION MARK character (!) to the comment token's data. [Reconsume](#) in the [comment state](#).

### 13.2.5.53 DOCTYPE state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [before DOCTYPE name state](#).

U+003E GREATER-THAN SIGN (>)

[Reconsume](#) in the [before DOCTYPE name state](#).

EOF

This is an [eof-in-doctype parse error](#). Create a new DOCTYPE token. Set its [force-quirks flag](#) to *on*. Emit the current token. Emit an end-of-file token.

## Anything else

This is a [missing-whitespace-before-doctype-name parse error](#). [Reconsume](#) in the [before DOCTYPE name state](#).

### 13.2.5.54 Before DOCTYPE name state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

## ASCII upper alpha

Create a new DOCTYPE token. Set the token's name to the lowercase version of the [current input character](#) (add 0x0020 to the character's code point). Switch to the [DOCTYPE name state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Create a new DOCTYPE token. Set the token's name to a U+FFFD REPLACEMENT CHARACTER character. Switch to the [DOCTYPE name state](#).

U+003E GREATER-THAN SIGN (>)

This is a [missing-doctype-name parse error](#). Create a new DOCTYPE token. Set its [force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current token.

EOF

This is an [eof-in-doctype parse error](#). Create a new DOCTYPE token. Set its [\*force-quirks flag\*](#) to *on*. Emit the current token. Emit an end-of-file token.

Anything else

Create a new DOCTYPE token. Set the token's name to the [current input character](#). Switch to the [DOCTYPE name state](#).

#### 13.2.5.55 DOCTYPE name state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [after DOCTYPE name state](#).

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current DOCTYPE token.

[ASCII upper alpha](#)

Append the lowercase version of the [current input character](#) (add 0x0020 to the character's code point) to the current DOCTYPE token's name.

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current DOCTYPE token's name.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [\*force-quirks flag\*](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current DOCTYPE token's name.

#### 13.2.5.56 After DOCTYPE name state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

If the six characters starting from the [current input character](#) are an [ASCII case-insensitive](#) match for the word "PUBLIC", then consume those characters and switch to the [after DOCTYPE public keyword state](#).

Otherwise, if the six characters starting from the [current input character](#) are an [ASCII case-insensitive](#) match for the word "SYSTEM", then consume those characters and switch to the [after DOCTYPE system keyword state](#).

Otherwise, this is an [invalid-character-sequence-after-doctype-name parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. [Reconsume](#) in the [bogus DOCTYPE state](#).

#### 13.2.5.57 After DOCTYPE public keyword state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [before DOCTYPE public identifier state](#).

U+0022 QUOTATION MARK ("")

This is a [missing-whitespace-after-doctype-public-keyword parse error](#). Set the current DOCTYPE token's public identifier to the empty string (not missing), then switch to the [DOCTYPE public identifier \(double-quoted\) state](#).

U+0027 APOSTROPHE ('')

This is a [missing-whitespace-after-doctype-public-keyword parse error](#). Set the current DOCTYPE token's public identifier to the empty string (not missing), then switch to the [DOCTYPE public identifier \(single-quoted\) state](#).

U+003E GREATER-THAN SIGN (>)

This is a [missing-doctype-public-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

This is a [missing-quote-before-doctype-public-identifier parse error](#). Set the current

DOCTYPE token's [force-quirks flag](#) to *on*. [Reconsume](#) in the [bogus DOCTYPE state](#).

#### 13.2.5.58 Before DOCTYPE public identifier state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

U+0022 QUOTATION MARK ("")

Set the current DOCTYPE token's public identifier to the empty string (not missing), then switch to the [DOCTYPE public identifier \(double-quoted\) state](#).

U+0027 APOSTROPHE ('')

Set the current DOCTYPE token's public identifier to the empty string (not missing), then switch to the [DOCTYPE public identifier \(single-quoted\) state](#).

U+003E GREATER-THAN SIGN (>)

This is a [missing-doctype-public-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

This is a [missing-quote-before-doctype-public-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. [Reconsume](#) in the [bogus DOCTYPE state](#).

#### 13.2.5.59 DOCTYPE public identifier (double-quoted) state

Consume the [next input character](#):

U+0022 QUOTATION MARK ("")

Switch to the [after DOCTYPE public identifier state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current DOCTYPE token's public identifier.

U+003E GREATER-THAN SIGN (>)

This is an [abrupt-doctype-public-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current DOCTYPE token's public identifier.

#### 13.2.5.60 DOCTYPE public identifier (single-quoted) state

Consume the [next input character](#):

U+0027 APOSTROPHE (')

Switch to the [after DOCTYPE public identifier state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current DOCTYPE token's public identifier.

U+003E GREATER-THAN SIGN (>)

This is an [abrupt-doctype-public-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current DOCTYPE token's public identifier.

#### 13.2.5.61 After DOCTYPE public identifier state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [between DOCTYPE public and system identifiers state](#).

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current DOCTYPE token.

U+0022 QUOTATION MARK ("")

This is a [missing-whitespace-between-doctype-public-and-system-identifiers parse error](#).

Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(double-quoted\) state](#).

## U+0027 APOSTROPHE (')

This is a [missing-whitespace-between-doctype-public-and-system-identifiers parse error](#).

Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(single-quoted\) state](#).

## EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

## Anything else

This is a [missing-quote-before-doctype-system-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. [Reconsume](#) in the [bogus DOCTYPE state](#).

### 13.2.5.62 Between DOCTYPE public and system identifiers state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current DOCTYPE token.

U+0022 QUOTATION MARK ("")

Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(double-quoted\) state](#).

U+0027 APOSTROPHE (')

Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(single-quoted\) state](#).

## EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

## Anything else

This is a [missing-quote-before-doctype-system-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. [Reconsume](#) in the [bogus DOCTYPE state](#).

### 13.2.5.63 After DOCTYPE system keyword state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Switch to the [before DOCTYPE system identifier state](#).

U+0022 QUOTATION MARK (")

This is a [missing-whitespace-after-doctype-system-keyword parse error](#). Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(double-quoted\) state](#).

U+0027 APOSTROPHE (')

This is a [missing-whitespace-after-doctype-system-keyword parse error](#). Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(single-quoted\) state](#).

U+003E GREATER-THAN SIGN (>)

This is a [missing-doctype-system-identifier parse error](#). Set the current DOCTYPE token's *force-quirks flag* to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's *force-quirks flag* to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

This is a [missing-quote-before-doctype-system-identifier parse error](#). Set the current DOCTYPE token's *force-quirks flag* to *on*. [Reconsume](#) in the [bogus DOCTYPE state](#).

### 13.2.5.64 Before DOCTYPE system identifier state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

U+0022 QUOTATION MARK (")

Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(double-quoted\) state](#).

U+0027 APOSTROPHE (')

Set the current DOCTYPE token's system identifier to the empty string (not missing), then switch to the [DOCTYPE system identifier \(single-quoted\) state](#).

U+003E GREATER-THAN SIGN (>)

This is a [missing-doctype-system-identifier parse error](#). Set the current DOCTYPE token's

[force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

This is a [missing-quote-before-doctype-system-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. [Reconsume](#) in the [bogus DOCTYPE state](#).

#### 13.2.5.65 DOCTYPE system identifier (double-quoted) state

Consume the [next input character](#):

U+0022 QUOTATION MARK ("")

Switch to the [after DOCTYPE system identifier state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current DOCTYPE token's system identifier.

U+003E GREATER-THAN SIGN (>)

This is an [abrupt-doctype-system-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current DOCTYPE token's system identifier.

#### 13.2.5.66 DOCTYPE system identifier (single-quoted) state

Consume the [next input character](#):

U+0027 APOSTROPHE ('')

Switch to the [after DOCTYPE system identifier state](#).

U+0000 NULL

This is an [unexpected-null-character parse error](#). Append a U+FFFD REPLACEMENT CHARACTER character to the current DOCTYPE token's system identifier.

U+003E GREATER-THAN SIGN (>)

This is an [abrupt-doctype-system-identifier parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

Append the [current input character](#) to the current DOCTYPE token's system identifier.

#### 13.2.5.67 After DOCTYPE system identifier state

Consume the [next input character](#):

U+0009 CHARACTER TABULATION (tab)

U+000A LINE FEED (LF)

U+000C FORM FEED (FF)

U+0020 SPACE

Ignore the character.

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the current DOCTYPE token.

EOF

This is an [eof-in-doctype parse error](#). Set the current DOCTYPE token's [force-quirks flag](#) to *on*. Emit the current DOCTYPE token. Emit an end-of-file token.

Anything else

This is an [unexpected-character-after-doctype-system-identifier parse error](#). [Reconsume](#) in the [bogus DOCTYPE state](#). (This does *not* set the current DOCTYPE token's [force-quirks flag](#) to *on*.)

#### 13.2.5.68 Bogus DOCTYPE state

Consume the [next input character](#):

U+003E GREATER-THAN SIGN (>)

Switch to the [data state](#). Emit the DOCTYPE token.

U+0000 NULL

This is an [unexpected-null-character parse error](#). Ignore the character.

EOF

Emit the DOCTYPE token. Emit an end-of-file token.

Anything else

Ignore the character.

#### 13.2.5.69 CDATA section state

Consume the [next input character](#):

U+005D RIGHT SQUARE BRACKET ()

Switch to the [CDATA section bracket state](#).

EOF

This is an [eof-in-cdata parse error](#). Emit an end-of-file token.

Anything else

Emit the [current input character](#) as a character token.

U+0000 NULL characters are handled in the tree construction stage, as part of the [in foreign content](#) insertion mode, which is the only place where CDATA sections can appear.

#### 13.2.5.70 CDATA section bracket state

Consume the [next input character](#):

U+005D RIGHT SQUARE BRACKET ()

Switch to the [CDATA section end state](#).

Anything else

Emit a U+005D RIGHT SQUARE BRACKET character token. [Reconsume](#) in the [CDATA section state](#).

#### 13.2.5.71 CDATA section end state

Consume the [next input character](#):

U+005D RIGHT SQUARE BRACKET ()

Emit a U+005D RIGHT SQUARE BRACKET character token.

U+003E GREATER-THAN SIGN character

Switch to the [data state](#).

Anything else

Emit two U+005D RIGHT SQUARE BRACKET character tokens. [Reconsume](#) in the [CDATA section state](#).

#### 13.2.5.72 Character reference state

Set the [temporary buffer](#) to the empty string. Append a U+0026 AMPERSAND (&) character to the [temporary buffer](#). Consume the [next input character](#):

[ASCII alphanumeric](#)

[Reconsume](#) in the [named character reference state](#).

U+0023 NUMBER SIGN (#)

Append the [current input character](#) to the [temporary buffer](#). Switch to the [numeric character reference state](#).

Anything else

Flush code points consumed as a character reference. Reconsume in the [return state](#).

#### 13.2.5.73 Named character reference state

Consume the maximum number of characters possible, where the consumed characters are one of the identifiers in the first column of the [named character references](#) table. Append each character to the [temporary buffer](#) when it's consumed.

If there is a match

If the character reference was [consumed as part of an attribute](#), and the last character matched is not a U+003B SEMICOLON character (;), and the [next input character](#) is either a U+003D EQUALS SIGN character (=) or an [ASCII alphanumeric](#), then, for historical reasons, [flush code points consumed as a character reference](#) and switch to the [return state](#).

Otherwise:

1. If the last character matched is not a U+003B SEMICOLON character (;), then this is a [missing-semicolon-after-character-reference parse error](#).
2. Set the [temporary buffer](#) to the empty string. Append one or two characters corresponding to the character reference name (as given by the second column of the [named character references](#) table) to the [temporary buffer](#).
3. [Flush code points consumed as a character reference](#). Switch to the [return state](#).

Otherwise

[Flush code points consumed as a character reference](#). Switch to the [ambiguous ampersand state](#).

If the markup contains (not in an attribute) the string I'm &notit; I tell you, the character reference is parsed as "not", as in, I'm -it; I tell you (and this is a parse error). But if the markup was I'm &notin; I tell you, the character reference would be parsed as "notin;", resulting in I'm € I tell you (and no parse error).

However, if the markup contains the string I'm &notit; I tell you in an attribute, no character reference is parsed and string remains intact (and there is no parse error).

#### 13.2.5.74 Ambiguous ampersand state

Consume the [next input character](#):

##### ASCII alphanumeric

If the character reference was [consumed as part of an attribute](#), then append the [current input character](#) to the current attribute's value. Otherwise, emit the [current input character](#) as a character token.

U+003B SEMICOLON (;)

This is an [unknown-named-character-reference parse error](#). [Reconsume](#) in the [return state](#).

Anything else

[Reconsume](#) in the [return state](#).

#### 13.2.5.75 Numeric character reference state

Set the *character reference code* to zero (0).

Consume the [next input character](#):

U+0078 LATIN SMALL LETTER X

U+0058 LATIN CAPITAL LETTER X

Append the [current input character](#) to the [temporary buffer](#). Switch to the [hexadecimal character reference start state](#).

Anything else

[Reconsume](#) in the [decimal character reference start state](#).

#### 13.2.5.76 Hexadecimal character reference start state

Consume the [next input character](#):

[ASCII hex digit](#)

[Reconsume](#) in the [hexadecimal character reference state](#).

Anything else

This is an [absence-of-digits-in-numeric-character-reference parse error](#). [Flush code points consumed as a character reference](#). [Reconsume](#) in the [return state](#).

#### 13.2.5.77 Decimal character reference start state

Consume the [next input character](#):

[ASCII digit](#)

[Reconsume](#) in the [decimal character reference state](#).

Anything else

This is an [absence-of-digits-in-numeric-character-reference parse error](#). [Flush code points consumed as a character reference](#). [Reconsume](#) in the [return state](#).

#### 13.2.5.78 Hexadecimal character reference state

Consume the [next input character](#):

[ASCII digit](#)

Multiply the [character reference code](#) by 16. Add a numeric version of the [current input](#)

character (subtract 0x0030 from the character's code point) to the character reference code.

#### ASCII upper hex digit

Multiply the character reference code by 16. Add a numeric version of the current input character as a hexadecimal digit (subtract 0x0037 from the character's code point) to the character reference code.

#### ASCII lower hex digit

Multiply the character reference code by 16. Add a numeric version of the current input character as a hexadecimal digit (subtract 0x0057 from the character's code point) to the character reference code.

#### **U+003B SEMICOLON**

Switch to the numeric character reference end state.

#### Anything else

This is a missing-semicolon-after-character-reference parse error. Reconsume in the numeric character reference end state.

#### 13.2.5.79 Decimal character reference state

Consume the next input character:

#### ASCII digit

Multiply the character reference code by 10. Add a numeric version of the current input character (subtract 0x0030 from the character's code point) to the character reference code.

#### **U+003B SEMICOLON**

Switch to the numeric character reference end state.

#### Anything else

This is a missing-semicolon-after-character-reference parse error. Reconsume in the numeric character reference end state.

#### 13.2.5.80 Numeric character reference end state

Check the character reference code:

- If the number is 0x00, then this is a null-character-reference parse error. Set the character reference code to 0xFFFFD.
- If the number is greater than 0x10FFFF, then this is a character-reference-outside-unicode-range parse error. Set the character reference code to 0xFFFFD.
- If the number is a surrogate, then this is a surrogate-character-reference parse error. Set the character reference code to 0xFFFFD.
- If the number is a noncharacter, then this is a noncharacter-character-reference parse

[error](#).

- If the number is 0x0D, or a [control](#) that's not [ASCII whitespace](#), then this is a [control-character-reference parse error](#). If the number is one of the numbers in the first column of the following table, then find the row with that number in the first column, and set the [character reference code](#) to the number in the second column of that row.

Number	Code point
0x80	0x20ACEURO SIGN (€)
0x82	0x201A SINGLE LOW-9 QUOTATION MARK („)
0x83	0x0192 LATIN SMALL LETTER F WITH HOOK (ƒ)
0x84	0x201E DOUBLE LOW-9 QUOTATION MARK („)
0x85	0x2026 HORIZONTAL ELLIPSIS (...)
0x86	0x2020 DAGGER (†)
0x87	0x2021 DOUBLE DAGGER (‡)
0x88	0x02C6 MODIFIER LETTER CIRCUMFLEX ACCENT (^)
0x89	0x2030 PER MILLE SIGN (‰)
0x8A	0x0160 LATIN CAPITAL LETTER S WITH CARON (Š)
0x8B	0x2039 SINGLE LEFT-POINTING ANGLE QUOTATION MARK (⟨)
0x8C	0x0152 LATIN CAPITAL LIGATURE OE (Œ)
0x8E	0x017D LATIN CAPITAL LETTER Z WITH CARON (Ž)
0x91	0x2018 LEFT SINGLE QUOTATION MARK (‘)
0x92	0x2019 RIGHT SINGLE QUOTATION MARK (’)
0x93	0x201C LEFT DOUBLE QUOTATION MARK (“)
0x94	0x201D RIGHT DOUBLE QUOTATION MARK (”)
0x95	0x2022 BULLET (•)
0x96	0x2013 EN DASH (–)
0x97	0x2014 EM DASH (—)
0x98	0x02DC SMALL TILDE (˜)
0x99	0x2122 TRADE MARK SIGN (™)
0x9A	0x0161 LATIN SMALL LETTER S WITH CARON (š)
0x9B	0x203A SINGLE RIGHT-POINTING ANGLE QUOTATION MARK (⟩)
0x9C	0x0153 LATIN SMALL LIGATURE OE (œ)
0x9E	0x017E LATIN SMALL LETTER Z WITH CARON (ž)
0x9F	0x0178 LATIN CAPITAL LETTER Y WITH DIAERESIS (Ÿ)

Set the [temporary buffer](#) to the empty string. Append a code point equal to the [character reference code](#) to the [temporary buffer](#). [Flush code points consumed as a character reference](#). Switch to the [return state](#).

### 13.2.6 Tree construction

The input to the tree construction stage is a sequence of tokens from the [tokenization](#) stage. The tree construction stage is associated with a DOM [Document](#) object when a parser is

created. The "output" of this stage consists of dynamically modifying or extending that document's DOM tree.

This specification does not define when an interactive user agent has to render the [Document](#) so that it is available to the user, or when it has to begin accepting user input.

---

As each token is emitted from the tokenizer, the user agent must follow the appropriate steps from the following list, known as the *tree construction dispatcher*:

If the [stack of open elements](#) is empty

If the [adjusted current node](#) is an element in the [HTML namespace](#)

If the [adjusted current node](#) is a [MathML text integration point](#) and the token is a start tag whose tag name is neither "mglyph" nor "malignmark"

If the [adjusted current node](#) is a [MathML text integration point](#) and the token is a character token

If the [adjusted current node](#) is a [MathML annotation-xml](#) element and the token is a start tag whose tag name is "svg"

If the [adjusted current node](#) is an [HTML integration point](#) and the token is a start tag

If the [adjusted current node](#) is an [HTML integration point](#) and the token is a character token

If the token is an end-of-file token

Process the token according to the rules given in the section corresponding to the current [insertion mode](#) in HTML content.

Otherwise

Process the token according to the rules given in the section for parsing tokens [in foreign content](#).

The *next token* is the token that is about to be processed by the [tree construction dispatcher](#) (even if the token is subsequently just ignored).

A node is a *MathML text integration point* if it is one of the following elements:

- A [MathML mi](#) element
- A [MathML mo](#) element
- A [MathML mn](#) element
- A [MathML ms](#) element
- A [MathML mtext](#) element

A node is an *HTML integration point* if it is one of the following elements:

- A [MathML annotation-xml](#) element whose start tag token had an attribute with the name "encoding" whose value was an [ASCII case-insensitive](#) match for the string "text/html"
- A [MathML annotation-xml](#) element whose start tag token had an attribute with the name "encoding" whose value was an [ASCII case-insensitive](#) match for the string "application/xhtml+xml"

- An [SVG `foreignObject`](#) element
- An [SVG `desc`](#) element
- An [SVG `title`](#) element

If the node in question is the [`context`](#) element passed to the [HTML fragment parsing algorithm](#), then the start tag token for that element is the "fake" token created during by that [HTML fragment parsing algorithm](#).

---

Not all of the tag names mentioned below are conformant tag names in this specification; many are included to handle legacy content. They still form part of the algorithm that implementations are required to implement to claim conformance.

The algorithm described below places no limit on the depth of the DOM tree generated, or on the length of tag names, attribute names, attribute values, [Text](#) nodes, etc. While implementers are encouraged to avoid arbitrary limits, it is recognized that [practical concerns](#) will likely force user agents to impose nesting depth constraints.

#### 13.2.6.1 Creating and inserting nodes

While the parser is processing a token, it can enable or disable *foster parenting*. This affects the following algorithm.

The *appropriate place for inserting a node*, optionally using a particular *override target*, is the position in an element returned by running the following steps:

1. If there was an *override target* specified, then let *target* be the *override target*.

Otherwise, let *target* be the [current node](#).

2. Determine the *adjusted insertion location* using the first matching steps from the following list:

If [foster parenting](#) is enabled and *target* is a [table](#), [tbody](#), [tfoot](#), [thead](#), or [tr](#) element

Foster parenting happens when content is misnested in tables.

Run these substeps:

1. Let *last template* be the last [template](#) element in the [stack of open elements](#), if any.
2. Let *last table* be the last [table](#) element in the [stack of open elements](#), if any.
3. If there is a *last template* and either there is no *last table*, or there is one, but

*last template* is lower (more recently added) than *last table* in the [stack of open elements](#), then: let *adjusted insertion location* be inside *last template*'s [template contents](#), after its last child (if any), and abort these steps.

4. If there is no *last table*, then let *adjusted insertion location* be inside the first element in the [stack of open elements](#) (the [html](#) element), after its last child (if any), and abort these steps. ([fragment case](#))
5. If *last table* has a parent node, then let *adjusted insertion location* be inside *last table*'s parent node, immediately before *last table*, and abort these steps.
6. Let *previous element* be the element immediately above *last table* in the [stack of open elements](#).
7. Let *adjusted insertion location* be inside *previous element*, after its last child (if any).

These steps are involved in part because it's possible for elements, the [table](#) element in this case in particular, to have been moved by a script around in the DOM, or indeed removed from the DOM entirely, after the element was inserted by the parser.

Otherwise

Let *adjusted insertion location* be inside *target*, after its last child (if any).

3. If the *adjusted insertion location* is inside a [template](#) element, let it instead be inside the [template](#) element's [template contents](#), after its last child (if any).
4. Return the *adjusted insertion location*.

---

When the steps below require the UA to *create an element for a token* in a particular *given namespace* and with a particular *intended parent*, the UA must run the following steps:

1. If the [active speculative HTML parser](#) is not null, then return the result of [creating a speculative mock element](#) given *given namespace*, the tag name of the given token, and the attributes of the given token.
2. Otherwise, optionally [create a speculative mock element](#) given *given namespace*, the tag name of the given token, and the attributes of the given token.

The result is not used. This step allows for a [speculative fetch](#) to be initiated from non-speculative parsing. The fetch is still speculative at this point, because, for example, by the time the element is inserted, *intended parent* might have been removed from the document.

3. Let *document* be *intended parent's node document*.
4. Let *local name* be the tag name of the token.
5. Let *is* be the value of the "[is](#)" attribute in the given token, if such an attribute exists, or null otherwise.
6. Let *definition* be the result of [looking up a custom element definition](#) given *document*, given namespace, *local name*, and *is*.
7. If *definition* is non-null and the parser was not created as part of the [HTML fragment parsing algorithm](#), then let *will execute script* be true. Otherwise, let it be false.
8. If *will execute script* is true, then:
  1. Increment *document's throw-on-dynamic-markup-insertion counter*.
  2. If the [JavaScript execution context stack](#) is empty, then [perform a microtask checkpoint](#).
  3. Push a new [element queue](#) onto *document's relevant agent's custom element reactions stack*.

9. Let *element* be the result of [creating an element](#) given *document*, *localName*, given namespace, null, and *is*. If *will execute script* is true, set the *synchronous custom elements flag*; otherwise, leave it unset.

This will cause [custom element constructors](#) to run, if *will execute script* is true. However, since we incremented the [throw-on-dynamic-markup-insertion counter](#), this cannot cause [new characters to be inserted into the tokenizer](#), or [the document to be blown away](#).

10. [Append](#) each attribute in the given token to *element*.

This can [enqueue a custom element callback reaction](#) for the **attributeChangedCallback**, which might run immediately (in the next step).

Even though the [is](#) attribute governs the [creation](#) of a [customized built-in element](#), it is not present during the execution of the relevant [custom element constructor](#); it is appended in this step, along with all other attributes.

11. If *will execute script* is true, then:

1. Let *queue* be the result of popping from *document's relevant agent's custom element reactions stack*. (This will be the same [element queue](#) as was pushed above.)
2. [Invoke custom element reactions](#) in *queue*.

3. Decrement document's [throw-on-dynamic-markup-insertion counter](#).
  12. If *element* has an `xmlns` attribute in the [XMLNS namespace](#) whose value is not exactly the same as the element's namespace, that is a [parse error](#). Similarly, if *element* has an `xmlns:xlink` attribute in the [XMLNS namespace](#) whose value is not the [XLink Namespace](#), that is a [parse error](#).
  13. If *element* is a [resettable element](#), invoke its [reset algorithm](#). (This initializes the element's [value](#) and [checkedness](#) based on the element's attributes.)
  14. If *element* is a [form-associated element](#) and not a [form-associated custom element](#), the [form element pointer](#) is not null, there is no [template](#) element on the [stack of open elements](#), *element* is either not [listed](#) or doesn't have a [form](#) attribute, and the [intended parent](#) is in the same [tree](#) as the element pointed to by the [form element pointer](#), then associate *element* with the [form](#) element pointed to by the [form element pointer](#) and set *element*'s [parser inserted flag](#).
  15. Return *element*.
- 

When the steps below require the user agent to *insert a foreign element* for a token in a given namespace, the user agent must run these steps:

1. Let the *adjusted insertion location* be the [appropriate place for inserting a node](#).
2. Let *element* be the result of [creating an element for the token](#) in the given namespace, with the intended parent being the element in which the *adjusted insertion location* finds itself.
3. If it is possible to insert *element* at the *adjusted insertion location*, then:
  1. If the parser was not created as part of the [HTML fragment parsing algorithm](#), then push a new [element queue](#) onto *element*'s [relevant agent](#)'s [custom element reactions stack](#).
  2. Insert *element* at the *adjusted insertion location*.
  3. If the parser was not created as part of the [HTML fragment parsing algorithm](#), then pop the [element queue](#) from *element*'s [relevant agent](#)'s [custom element reactions stack](#), and [invoke custom element reactions](#) in that queue.

If the *adjusted insertion location* cannot accept more elements, e.g. because it's a [Document](#) that already has an element child, then *element* is dropped on the floor.

4. Push *element* onto the [stack of open elements](#) so that it is the new [current node](#).
5. Return *element*.

When the steps below require the user agent to *insert an HTML element* for a token, the user agent must [insert a foreign element](#) for the token, in the [HTML namespace](#).

---

When the steps below require the user agent to *adjust MathML attributes* for a token, then, if the token has an attribute named **definitionurl**, change its name to **definitionURL** (note the case difference).

When the steps below require the user agent to *adjust SVG attributes* for a token, then, for each attribute on the token whose attribute name is one of the ones in the first column of the following table, change the attribute's name to the name given in the corresponding cell in the second column. (This fixes the case of SVG attributes that are not all lowercase.)

Attribute name on token	Attribute name on element
attributename	attributeName
attributetype	attributeType
basefrequency	baseFrequency
baseprofile	baseProfile
calcmode	calcMode
clippathunits	clipPathUnits
diffuseconstant	diffuseConstant
edgemode	edgeMode
filterunits	filterUnits
glyphref	glyphRef
gradienttransform	gradientTransform
gradientunits	gradientUnits
kernelmatrix	kernelMatrix
kernelunitlength	kernelUnitLength
keypoints	keyPoints
keysplines	keySplines
keytimes	keyTimes
lengthadjust	lengthAdjust
limitingconeangle	limitingConeAngle
markerheight	markerHeight
markerunits	markerUnits
markerwidth	markerWidth
maskcontentunits	maskContentUnits
maskunits	maskUnits
numoctaves	numOctaves
pathlength	pathLength
patterncontentunits	patternContentUnits
patterntransform	patternTransform
patternunits	patternUnits

Attribute name on token	Attribute name on element
pointsatx	pointsAtX
pointsaty	pointsAtY
pointsatz	pointsAtZ
preservealpha	preserveAlpha
preserveaspectratio	preserveAspectRatio
primitiveunits	primitiveUnits
refx	refX
refy	refY
repeatcount	repeatCount
repeatdur	repeatDur
requiredextensions	requiredExtensions
requiredfeatures	requiredFeatures
specularconstant	specularConstant
specularexponent	specularExponent
spreadmethod	spreadMethod
startoffset	startOffset
stddeviation	stdDeviation
stitchtiles	stitchTiles
surfacescale	surfaceScale
systemlanguage	systemLanguage
tablevalues	tableValues
targetx	targetX
targety	targetY
textlength	textLength
viewbox	viewBox
viewtarget	viewTarget
xchannelselector	xChannelSelector
ychannelselector	yChannelSelector
zoomandpan	zoomAndPan

When the steps below require the user agent to *adjust foreign attributes* for a token, then, if any of the attributes on the token match the strings given in the first column of the following table, let the attribute be a namespaced attribute, with the prefix being the string given in the corresponding cell in the second column, the local name being the string given in the corresponding cell in the third column, and the namespace being the namespace given in the corresponding cell in the fourth column. (This fixes the use of namespaced attributes, in particular [lang attributes in the XML namespace](#).)

Attribute name	Prefix	Local name	Namespace
xlink:actuate	xlink	actuate	<a href="#">XLink namespace</a>
xlink:arcrole	xlink	arcrole	<a href="#">XLink namespace</a>

Attribute name	Prefix	Local name	Namespace
xlink:href	xlink	href	<a href="#">XLink namespace</a>
xlink:role	xlink	role	<a href="#">XLink namespace</a>
xlink:show	xlink	show	<a href="#">XLink namespace</a>
xlink:title	xlink	title	<a href="#">XLink namespace</a>
xlink:type	xlink	type	<a href="#">XLink namespace</a>
xml:lang	xml	lang	<a href="#">XML namespace</a>
xml:space	xml	space	<a href="#">XML namespace</a>
xmlns		(none)	<a href="#">XMLNS namespace</a>
xmlns:xlink	xmlns	xlink	<a href="#">XMLNS namespace</a>

---

When the steps below require the user agent to *insert a character* while processing a token, the user agent must run the following steps:

1. Let *data* be the characters passed to the algorithm, or, if no characters were explicitly specified, the character of the character token being processed.
2. Let the *adjusted insertion location* be the [appropriate place for inserting a node](#).
3. If the *adjusted insertion location* is in a [Document](#) node, then return.

The DOM will not let [Document](#) nodes have [Text](#) node children, so they are dropped on the floor.

4. If there is a [Text](#) node immediately before the *adjusted insertion location*, then append *data* to that [Text](#) node's data.

Otherwise, create a new [Text](#) node whose data is *data* and whose [node document](#) is the same as that of the element in which the *adjusted insertion location* finds itself, and insert the newly created node at the *adjusted insertion location*.

Here are some sample inputs to the parser and the corresponding number of [Text](#) nodes that they result in, assuming a user agent that executes scripts.

Input	Number of <a href="#">Text</a> nodes
<pre>A&lt;script&gt; var script = document.getElementsByTagName('script')[0]; document.body.removeChild(script); &lt;/script&gt;B</pre>	One <a href="#">Text</a> node in the document, containing "AB".

Input	Number of <u>Text</u> nodes
A<script> var text = document.createTextNode('B'); document.body.appendChild(text); </script>C	Three <u>Text</u> nodes; "A" before the script, the script's contents, and "BC" after the script (the parser appends to the <u>Text</u> node created by the script).
A<script> var text = document.getElementsByTagName('script')[0].firstChild; text.data = 'B'; document.body.appendChild(text); </script>C	Two adjacent <u>Text</u> nodes in the document, containing "A" and "BC".
A<table>B<tr>C</tr>D</table>	One <u>Text</u> node before the table, containing "ABCD". (This is caused by <a href="#">foster parenting</a> .)
A<table><tr> B</tr> C</table>	One <u>Text</u> node before the table, containing "A B C" (A-space- B-space-

Input	Number of <u>Text</u> nodes
A<table><tr> B</tr> </em>C</table>	C). (This is caused by <u>foster parenting</u> .) One <u>Text</u> node before the table, containing "A BC" (A-space-B-C), and one <u>Text</u> node inside the table (as a child of a <u>tbody</u> ) with a single space character. (Space characters separated from non-space characters by non-character tokens are not affected by <u>foster parenting</u> , even if those other tokens then get ignored.)

---

When the steps below require the user agent to *insert a comment* while processing a comment

token, optionally with an explicitly insertion position *position*, the user agent must run the following steps:

1. Let *data* be the data given in the comment token being processed.
  2. If *position* was specified, then let the *adjusted insertion location* be *position*. Otherwise, let *adjusted insertion location* be the [appropriate place for inserting a node](#).
  3. Create a [Comment](#) node whose **data** attribute is set to *data* and whose [node document](#) is the same as that of the node in which the *adjusted insertion location* finds itself.
  4. Insert the newly created node at the *adjusted insertion location*.
- 

DOM mutation events must not fire for changes caused by the UA parsing the document. This includes the parsing of any content inserted using [document.write\(\)](#) and [document.writeln\(\)](#) calls. [\[UIEVENTS\]](#)

However, [mutation observers](#) *do* fire, as required by *DOM*.

#### 13.2.6.2 Parsing elements that contain only text

The *generic raw text element parsing algorithm* and the *generic RCDATA element parsing algorithm* consist of the following steps. These algorithms are always invoked in response to a start tag token.

1. [Insert an HTML element](#) for the token.
2. If the algorithm that was invoked is the [generic raw text element parsing algorithm](#), switch the tokenizer to the [RAWTEXT state](#); otherwise the algorithm invoked was the [generic RCDATA element parsing algorithm](#), switch the tokenizer to the [RCDATA state](#).
3. Let the [original insertion mode](#) be the current [insertion mode](#).
4. Then, switch the [insertion mode](#) to "text".

#### 13.2.6.3 Closing elements that have implied end tags

When the steps below require the UA to generate *implied end tags*, then, while the [current node](#) is a [dd](#) element, a [dt](#) element, an [li](#) element, an [optgroup](#) element, an [option](#) element, a [p](#) element, an [rb](#) element, an [rp](#) element, an [rt](#) element, or an [rtc](#) element, the UA must pop the [current node](#) off the [stack of open elements](#).

If a step requires the UA to generate implied end tags but lists an element to exclude from the process, then the UA must perform the above steps as if that element was not in the above list.

When the steps below require the UA to generate *all implied end tags thoroughly*, then, while the [current node](#) is a [caption](#) element, a [colgroup](#) element, a [dd](#) element, a [dt](#) element, an [li](#) element, an [optgroup](#) element, an [option](#) element, a [p](#) element, an [rb](#) element, an [rp](#) element, an [rt](#) element, an [rtc](#) element, a [tbody](#) element, a [td](#) element, a [tfoot](#) element, a [th](#) element, a [thead](#) element, or a [tr](#) element, the UA must pop the [current node](#) off the [stack of open elements](#).

#### 13.2.6.4 The rules for parsing tokens in HTML content

##### 13.2.6.4.1 The "initial" insertion mode

A [Document](#) object has an associated *parser cannot change the mode flag* (a boolean). It is initially false.

When the user agent is to apply the rules for the "[initial](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

Ignore the token.

A comment token

[Insert a comment](#) as the last child of the [Document](#) object.

A DOCTYPE token

If the DOCTYPE token's name is not "[html](#)", or the token's public identifier is not missing, or the token's system identifier is neither missing nor "[about:legacy-compat](#)", then there is a [parse error](#).

Append a [DocumentType](#) node to the [Document](#) node, with the **name** attribute set to the name given in the DOCTYPE token, or the empty string if the name was missing; the **publicId** attribute set to the public identifier given in the DOCTYPE token, or the empty string if the public identifier was missing; the **systemId** attribute set to the system identifier given in the DOCTYPE token, or the empty string if the system identifier was missing; and the other attributes specific to [DocumentType](#) objects set to null and empty lists as appropriate. Associate the [DocumentType](#) node with the [Document](#) object so that it is returned as the value of the **doctype** attribute of the [Document](#) object.

Then, if the document is *not* [an iframe srcdoc document](#), and the *parser cannot change the mode flag* is false, and the DOCTYPE token matches one of the conditions in the following list, then set the [Document](#) to [quirks mode](#):

- The [force-quirks flag](#) is set to *on*.

- The name is not "html".
- The public identifier is set to: "-//W3O//DTD W3 HTML Strict 3.0//EN//"
- The public identifier is set to: "-//W3C/DTD HTML 4.0 Transitional//EN"
- The public identifier is set to: "HTML"
- The system identifier is set to: "http://www.ibm.com/data/dtd/v11/ibmxhtml1-transitional.dtd"
- The public identifier starts with: "+//Silmaril//dtd html Pro v0r11 19970101//"
- The public identifier starts with: "-//AS//DTD HTML 3.0 asWedit + extensions//"
- The public identifier starts with: "-//AdvaSoft Ltd//DTD HTML 3.0 asWedit + extensions//"
- The public identifier starts with: "-//IETF//DTD HTML 2.0 Level 1//"
- The public identifier starts with: "-//IETF//DTD HTML 2.0 Level 2//"
- The public identifier starts with: "-//IETF//DTD HTML 2.0 Strict Level 1//"
- The public identifier starts with: "-//IETF//DTD HTML 2.0 Strict Level 2//"
- The public identifier starts with: "-//IETF//DTD HTML 2.0 Strict//"
- The public identifier starts with: "-//IETF//DTD HTML 2.0//"
- The public identifier starts with: "-//IETF//DTD HTML 2.1E//"
- The public identifier starts with: "-//IETF//DTD HTML 3.0//"
- The public identifier starts with: "-//IETF//DTD HTML 3.2 Final//"
- The public identifier starts with: "-//IETF//DTD HTML 3.2//"
- The public identifier starts with: "-//IETF//DTD HTML 3//"
- The public identifier starts with: "-//IETF//DTD HTML Level 0//"
- The public identifier starts with: "-//IETF//DTD HTML Level 1//"
- The public identifier starts with: "-//IETF//DTD HTML Level 2//"
- The public identifier starts with: "-//IETF//DTD HTML Level 3//"
- The public identifier starts with: "-//IETF//DTD HTML Strict Level 0//"
- The public identifier starts with: "-//IETF//DTD HTML Strict Level 1//"
- The public identifier starts with: "-//IETF//DTD HTML Strict Level 2//"
- The public identifier starts with: "-//IETF//DTD HTML Strict Level 3//"
- The public identifier starts with: "-//IETF//DTD HTML Strict//"
- The public identifier starts with: "-//IETF//DTD HTML//"
- The public identifier starts with: "-//Metrius//DTD Metrius Presentational//"
- The public identifier starts with: "-//Microsoft//DTD Internet Explorer 2.0 HTML Strict//"
- The public identifier starts with: "-//Microsoft//DTD Internet Explorer 2.0 HTML//"
- The public identifier starts with: "-//Microsoft//DTD Internet Explorer 2.0 Tables//"
- The public identifier starts with: "-//Microsoft//DTD Internet Explorer 3.0 HTML Strict//"

- The public identifier starts with: "-//Microsoft//DTD Internet Explorer 3.0 HTML//"
- The public identifier starts with: "-//Microsoft//DTD Internet Explorer 3.0 Tables//"
- The public identifier starts with: "-//Netscape Comm. Corp./DTD HTML//"
- The public identifier starts with: "-//Netscape Comm. Corp./DTD Strict HTML//"
- The public identifier starts with: "-//O'Reilly and Associates//DTD HTML 2.0//"
- The public identifier starts with: "-//O'Reilly and Associates//DTD HTML Extended 1.0//"
- The public identifier starts with: "-//O'Reilly and Associates//DTD HTML Extended Relaxed 1.0//"
- The public identifier starts with: "-//SQ//DTD HTML 2.0 HoTMetaL + extensions//"
- The public identifier starts with: "-//SoftQuad Software//DTD HoTMetaL PRO 6.0:::19990601::extensions to HTML 4.0//"
- The public identifier starts with: "-//SoftQuad//DTD HoTMetaL PRO 4.0:::19971010::extensions to HTML 4.0//"
- The public identifier starts with: "-//Spyglass//DTD HTML 2.0 Extended//"
- The public identifier starts with: "-//Sun Microsystems Corp./DTD HotJava HTML//"
- The public identifier starts with: "-//Sun Microsystems Corp./DTD HotJava Strict HTML//"
- The public identifier starts with: "-//W3C//DTD HTML 3 1995-03-24//"
- The public identifier starts with: "-//W3C//DTD HTML 3.2 Draft//"
- The public identifier starts with: "-//W3C//DTD HTML 3.2 Final//"
- The public identifier starts with: "-//W3C//DTD HTML 3.2//"
- The public identifier starts with: "-//W3C//DTD HTML 3.2S Draft//"
- The public identifier starts with: "-//W3C//DTD HTML 4.0 Frameset//"
- The public identifier starts with: "-//W3C//DTD HTML 4.0 Transitional//"
- The public identifier starts with: "-//W3C//DTD HTML Experimental 19960712//"
- The public identifier starts with: "-//W3C//DTD HTML Experimental 970421//"
- The public identifier starts with: "-//W3C//DTD W3 HTML//"
- The public identifier starts with: "-//W30//DTD W3 HTML 3.0//"
- The public identifier starts with: "-//WebTechs//DTD Mozilla HTML 2.0//"
- The public identifier starts with: "-//WebTechs//DTD Mozilla HTML//"
- The system identifier is missing and the public identifier starts with: "-//W3C//DTD HTML 4.01 Frameset//"
- The system identifier is missing and the public identifier starts with: "-//W3C//DTD HTML 4.01 Transitional//"

Otherwise, if the document is *not* an [iframe srcdoc](#) document, and the parser cannot

[change the mode flag](#) is false, and the DOCTYPE token matches one of the conditions in the following list, then then set the [Document](#) to [limited-quirks mode](#):

- The public identifier starts with: "-//W3C//DTD XHTML 1.0 Frameset//"
- The public identifier starts with: "-//W3C//DTD XHTML 1.0 Transitional//"
- The system identifier is not missing and the public identifier starts with:  
"-//W3C//DTD HTML 4.01 Frameset//"
- The system identifier is not missing and the public identifier starts with:  
"-//W3C//DTD HTML 4.01 Transitional//"

The system identifier and public identifier strings must be compared to the values given in the lists above in an [ASCII case-insensitive](#) manner. A system identifier whose value is the empty string is not considered missing for the purposes of the conditions above.

Then, switch the [insertion mode](#) to "before html".

## Anything else

If the document is *not* [an iframe srcdoc document](#), then this is a [parse error](#); if the [parser cannot change the mode flag](#) is false, set the [Document](#) to [quirks mode](#).

In any case, switch the [insertion mode](#) to "before html", then reprocess the token.

### 13.2.6.4.2 The "before html" insertion mode

When the user agent is to apply the rules for the "[before html](#)" [insertion mode](#), the user agent must handle the token as follows:

#### A DOCTYPE token

[Parse error](#). Ignore the token.

#### A comment token

[Insert a comment](#) as the last child of the [Document](#) object.

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

Ignore the token.

#### A start tag whose tag name is "html"

[Create an element for the token](#) in the [HTML namespace](#), with the [Document](#) as the intended parent. Append it to the [Document](#) object. Put this element in the [stack of open elements](#).

Switch the [insertion mode](#) to "before head".

An end tag whose tag name is one of: "head", "body", "html", "br"

Act as described in the "anything else" entry below.

Any other end tag

[Parse error](#). Ignore the token.

Anything else

Create an [html](#) element whose [node document](#) is the [Document](#) object. Append it to the [Document](#) object. Put this element in the [stack of open elements](#).

Switch the [insertion mode](#) to "before head", then reprocess the token.

The [document element](#) can end up being removed from the [Document](#) object, e.g. by scripts; nothing in particular happens in such cases, content continues being appended to the nodes as described in the next section.

#### 13.2.6.4.3 The "before head" insertion mode

When the user agent is to apply the rules for the "[before head](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

Ignore the token.

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

A start tag whose tag name is "head"

[Insert an HTML element](#) for the token.

Set the [head element pointer](#) to the newly created [head](#) element.

Switch the [insertion mode](#) to "[in head](#)".

An end tag whose tag name is one of: "head", "body", "html", "br"

Act as described in the "anything else" entry below.

Any other end tag

[Parse error](#). Ignore the token.

Anything else

[Insert an HTML element](#) for a "head" start tag token with no attributes.

Set the [head element pointer](#) to the newly created [head](#) element.

Switch the [insertion mode](#) to "[in head](#)".

Reprocess the current token.

#### 13.2.6.4.4 The "*in head*" insertion mode

When the user agent is to apply the rules for the "[in head](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

[Insert the character](#).

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for the "in body" insertion mode](#).

A start tag whose tag name is one of: "base", "basefont", "bgsound", "link"

[Insert an HTML element](#) for the token. Immediately pop the [current node](#) off the [stack of open elements](#).

[Acknowledge the token's self-closing flag](#), if it is set.

A start tag whose tag name is "meta"

Insert an HTML element for the token. Immediately pop the current node off the stack of open elements.

Acknowledge the token's *self-closing flag*, if it is set.

If the active speculative HTML parser is null, then:

1. If the element has a charset attribute, and getting an encoding from its value results in an encoding, and the confidence is currently *tentative*, then change the encoding to the resulting encoding.
2. Otherwise, if the element has an http-equiv attribute whose value is an ASCII case-insensitive match for the string "**Content-Type**", and the element has a content attribute, and applying the algorithm for extracting a character encoding from a meta element to that attribute's value returns an encoding, and the confidence is currently *tentative*, then change the encoding to the extracted encoding.

The speculative HTML parser doesn't speculatively apply character encoding declarations in order to reduce implementation complexity.

A start tag whose tag name is "title"

Follow the generic RCDATA element parsing algorithm.

A start tag whose tag name is "noscript", if the scripting flag is enabled  
A start tag whose tag name is one of: "noframes", "style"

Follow the generic raw text element parsing algorithm.

A start tag whose tag name is "noscript", if the scripting flag is disabled

Insert an HTML element for the token.

Switch the insertion mode to "in head noscript".

A start tag whose tag name is "script"

Run these steps:

1. Let the *adjusted insertion location* be the appropriate place for inserting a node.
2. Create an element for the token in the HTML namespace, with the intended parent being the element in which the *adjusted insertion location* finds itself.
3. Set the element's parser document to the Document, and unset the element's "non-

blocking" flag.

This ensures that, if the script is external, any `document.write()` calls in the script will execute in-line, instead of blowing the document away, as would happen in most other cases. It also prevents the script from executing until the end tag is seen.

4. If the parser was created as part of the HTML fragment parsing algorithm, then mark the `script` element as "already started". (fragment case)
5. If the parser was invoked via the `document.write()` or `document.writeln()` methods, then optionally mark the `script` element as "already started". (For example, the user agent might use this clause to prevent execution of cross-origin scripts inserted via `document.write()` under slow network conditions, or when the page has already taken a long time to load.)
6. Insert the newly created element at the *adjusted insertion location*.
7. Push the element onto the stack of open elements so that it is the new current node.
8. Switch the tokenizer to the script data state.
9. Let the original insertion mode be the current insertion mode.
10. Switch the insertion mode to "text".

An end tag whose tag name is "head"

Pop the current node (which will be the `head` element) off the stack of open elements.

Switch the insertion mode to "after head".

An end tag whose tag name is one of: "body", "html", "br"

Act as described in the "anything else" entry below.

A start tag whose tag name is "template"

Insert an HTML element for the token.

Insert a marker at the end of the list of active formatting elements.

Set the frameset-ok flag to "not ok".

Switch the insertion mode to "in template".

Push "in template" onto the stack of template insertion modes so that it is the new current template insertion mode.

A end tag whose tag name is "template"

If there is no [template](#) element on the [stack of open elements](#), then this is a [parse error](#); ignore the token.

Otherwise, run these steps:

1. [Generate all implied end tags thoroughly](#).
2. If the [current node](#) is not a [template](#) element, then this is a [parse error](#).
3. Pop elements from the [stack of open elements](#) until a [template](#) element has been popped from the stack.
4. [Clear the list of active formatting elements up to the last marker](#).
5. Pop the [current template insertion mode](#) off the [stack of template insertion modes](#).
6. [Reset the insertion mode appropriately](#).

A start tag whose tag name is "head"

Any other end tag

[Parse error](#). Ignore the token.

Anything else

Pop the [current node](#) (which will be the [head](#) element) off the [stack of open elements](#).

Switch the [insertion mode](#) to "[after head](#)".

Reprocess the token.

#### 13.2.6.4.5 The "*in head noscript*" insertion mode

When the user agent is to apply the rules for the "[in head noscript](#)" [insertion mode](#), the user agent must handle the token as follows:

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

An end tag whose tag name is "noscript"

Pop the [current node](#) (which will be a **noscript** element) from the [stack of open elements](#); the new [current node](#) will be a **head** element.

Switch the [insertion mode](#) to "[in head](#)".

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

A comment token

A start tag whose tag name is one of: "basefont", "bgsound", "link", "meta", "noframes", "style"

Process the token [using the rules for the "in head" insertion mode](#).

An end tag whose tag name is "br"

Act as described in the "anything else" entry below.

A start tag whose tag name is one of: "head", "noscript"

Any other end tag

[Parse error](#). Ignore the token.

Anything else

[Parse error](#).

Pop the [current node](#) (which will be a **noscript** element) from the [stack of open elements](#); the new [current node](#) will be a **head** element.

Switch the [insertion mode](#) to "[in head](#)".

Reprocess the token.

#### 13.2.6.4.6 The "after head" insertion mode

When the user agent is to apply the rules for the "[after head](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

[Insert the character](#).

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

A start tag whose tag name is "body"

[Insert an HTML element](#) for the token.

Set the [frameset-ok flag](#) to "not ok".

Switch the [insertion mode](#) to "[in body](#)".

A start tag whose tag name is "frameset"

[Insert an HTML element](#) for the token.

Switch the [insertion mode](#) to "[in frameset](#)".

A start tag whose tag name is one of: "base", "basefont", "bgsound", "link", "meta", "noframes", "script", "style", "template", "title"

[Parse error](#).

Push the node pointed to by the [head element pointer](#) onto the [stack of open elements](#).

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

Remove the node pointed to by the [head element pointer](#) from the [stack of open elements](#).  
(It might not be the [current node](#) at this point.)

The [head element pointer](#) cannot be null at this point.

An end tag whose tag name is "template"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

An end tag whose tag name is one of: "body", "html", "br"

Act as described in the "anything else" entry below.

A start tag whose tag name is "head"

Any other end tag

[Parse error](#). Ignore the token.

Anything else

[Insert an HTML element](#) for a "body" start tag token with no attributes.

Switch the [insertion mode](#) to "[in body](#)".

Reprocess the current token.

#### 13.2.6.4.7 The "[in body](#)" insertion mode

When the user agent is to apply the rules for the "[in body](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is U+0000 NULL

[Parse error](#). Ignore the token.

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

[Reconstruct the active formatting elements](#), if any.

[Insert the token's character](#).

Any other character token

[Reconstruct the active formatting elements](#), if any.

[Insert the token's character](#).

Set the [frameset-ok flag](#) to "not ok".

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

[Parse error](#).

If there is a [template](#) element on the [stack of open elements](#), then ignore the token.

Otherwise, for each attribute on the token, check to see if the attribute is already present on the top element of the [stack of open elements](#). If it is not, add the attribute and its

corresponding value to that element.

A start tag whose tag name is one of: "base", "basefont", "bgsound", "link", "meta", "noframes", "script", "style", "template", "title"

An end tag whose tag name is "template"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

A start tag whose tag name is "body"

[Parse error](#).

If the second element on the [stack of open elements](#) is not a [body](#) element, if the [stack of open elements](#) has only one node on it, or if there is a [template](#) element on the [stack of open elements](#), then ignore the token. ([fragment case](#))

Otherwise, set the [frameset-ok flag](#) to "not ok"; then, for each attribute on the token, check to see if the attribute is already present on the [body](#) element (the second element) on the [stack of open elements](#), and if it is not, add the attribute and its corresponding value to that element.

A start tag whose tag name is "frameset"

[Parse error](#).

If the [stack of open elements](#) has only one node on it, or if the second element on the [stack of open elements](#) is not a [body](#) element, then ignore the token. ([fragment case](#))

If the [frameset-ok flag](#) is set to "not ok", ignore the token.

Otherwise, run the following steps:

1. Remove the second element on the [stack of open elements](#) from its parent node, if it has one.
2. Pop all the nodes from the bottom of the [stack of open elements](#), from the [current node](#) up to, but not including, the root [html](#) element.
3. [Insert an HTML element](#) for the token.
4. Switch the [insertion mode](#) to "[in frameset](#)".

An end-of-file token

If the [stack of template insertion modes](#) is not empty, then process the token [using the rules for](#) the "[in template](#)" [insertion mode](#).

Otherwise, follow these steps:

1. If there is a node in the [stack of open elements](#) that is not either a [dd](#) element, a [dt](#) element, an [li](#) element, an [optgroup](#) element, an [option](#) element, a [p](#) element, an [rb](#) element, an [rp](#) element, an [rt](#) element, an [rtc](#) element, a [tbody](#) element, a [td](#) element, a [tfoot](#) element, a [th](#) element, a [thead](#) element, a [tr](#) element, the [body](#) element, or the [html](#) element, then this is a [parse error](#).
2. [Stop parsing](#).

An end tag whose tag name is "body"

If the [stack of open elements](#) does not [have a body element in scope](#), this is a [parse error](#); ignore the token.

Otherwise, if there is a node in the [stack of open elements](#) that is not either a [dd](#) element, a [dt](#) element, an [li](#) element, an [optgroup](#) element, an [option](#) element, a [p](#) element, an [rb](#) element, an [rp](#) element, an [rt](#) element, an [rtc](#) element, a [tbody](#) element, a [td](#) element, a [tfoot](#) element, a [th](#) element, a [thead](#) element, a [tr](#) element, the [body](#) element, or the [html](#) element, then this is a [parse error](#).

Switch the [insertion mode](#) to "[after body](#)".

An end tag whose tag name is "html"

If the [stack of open elements](#) does not [have a body element in scope](#), this is a [parse error](#); ignore the token.

Otherwise, if there is a node in the [stack of open elements](#) that is not either a [dd](#) element, a [dt](#) element, an [li](#) element, an [optgroup](#) element, an [option](#) element, a [p](#) element, an [rb](#) element, an [rp](#) element, an [rt](#) element, an [rtc](#) element, a [tbody](#) element, a [td](#) element, a [tfoot](#) element, a [th](#) element, a [thead](#) element, a [tr](#) element, the [body](#) element, or the [html](#) element, then this is a [parse error](#).

Switch the [insertion mode](#) to "[after body](#)".

Reprocess the token.

A start tag whose tag name is one of: "address", "article", "aside", "blockquote", "center", "details", "dialog", "dir", "div", "dl", "fieldset", "figcaption", "figure", "footer", "header", "hgroup", "main", "menu", "nav", "ol", "p", "section", "summary", "ul"

If the [stack of open elements](#) has a [p](#) element in [button scope](#), then [close a p element](#).

[Insert an HTML element](#) for the token.

A start tag whose tag name is one of: "h1", "h2", "h3", "h4", "h5", "h6"

If the [stack of open elements](#) has a [p](#) element in [button scope](#), then [close a p element](#).

If the [current node](#) is an [HTML element](#) whose tag name is one of "h1", "h2", "h3", "h4", "h5", or "h6", then this is a [parse error](#); pop the [current node](#) off the [stack of open elements](#).

[Insert an HTML element](#) for the token.

A start tag whose tag name is one of: "pre", "listing"

If the [stack of open elements has a p element in button scope](#), then [close a p element](#).

[Insert an HTML element](#) for the token.

If the [next token](#) is a U+000A LINE FEED (LF) character token, then ignore that token and move on to the next one. (Newlines at the start of [pre](#) blocks are ignored as an authoring convenience.)

Set the [frameset-ok flag](#) to "not ok".

A start tag whose tag name is "form"

If the [form element pointer](#) is not null, and there is no [template element](#) on the [stack of open elements](#), then this is a [parse error](#); ignore the token.

Otherwise:

If the [stack of open elements has a p element in button scope](#), then [close a p element](#).

[Insert an HTML element](#) for the token, and, if there is no [template element](#) on the [stack of open elements](#), set the [form element pointer](#) to point to the element created.

A start tag whose tag name is "li"

Run these steps:

1. Set the [frameset-ok flag](#) to "not ok".
2. Initialize *node* to be the [current node](#) (the bottommost node of the stack).
3. *Loop*: If *node* is an [li](#) element, then run these substeps:
  1. [Generate implied end tags](#), except for [li](#) elements.
  2. If the [current node](#) is not an [li](#) element, then this is a [parse error](#).
  3. Pop elements from the [stack of open elements](#) until an [li](#) element has been popped from the stack.
  4. Jump to the step labeled *done* below.

4. If *node* is in the [special](#) category, but is not an [address](#), [div](#), or [p](#) element, then jump to the step labeled *done* below.
5. Otherwise, set *node* to the previous entry in the [stack of open elements](#) and return to the step labeled *loop*.
6. *Done*: If the [stack of open elements](#) has a [p](#) element in button scope, then [close a p element](#).
7. Finally, [insert an HTML element](#) for the token.

A start tag whose tag name is one of: "dd", "dt"

Run these steps:

1. Set the [frameset-ok flag](#) to "not ok".
2. Initialize *node* to be the [current node](#) (the bottommost node of the stack).
3. *Loop*: If *node* is a [dd](#) element, then run these substeps:
  1. [Generate implied end tags](#), except for [dd](#) elements.
  2. If the [current node](#) is not a [dd](#) element, then this is a [parse error](#).
  3. Pop elements from the [stack of open elements](#) until a [dd](#) element has been popped from the stack.
  4. Jump to the step labeled *done* below.
4. If *node* is a [dt](#) element, then run these substeps:
  1. [Generate implied end tags](#), except for [dt](#) elements.
  2. If the [current node](#) is not a [dt](#) element, then this is a [parse error](#).
  3. Pop elements from the [stack of open elements](#) until a [dt](#) element has been popped from the stack.
  4. Jump to the step labeled *done* below.
5. If *node* is in the [special](#) category, but is not an [address](#), [div](#), or [p](#) element, then jump to the step labeled *done* below.
6. Otherwise, set *node* to the previous entry in the [stack of open elements](#) and return to the step labeled *loop*.
7. *Done*: If the [stack of open elements](#) has a [p](#) element in button scope, then [close a p](#)

[element](#).

8. Finally, [insert an HTML element](#) for the token.

A start tag whose tag name is "plaintext"

If the [stack of open elements has a p element in button scope](#), then [close a p element](#).

[Insert an HTML element](#) for the token.

Switch the tokenizer to the [PLAINTEXT state](#).

Once a start tag with the tag name "plaintext" has been seen, that will be the last token ever seen other than character tokens (and the end-of-file token), because there is no way to switch out of the [PLAINTEXT state](#).

A start tag whose tag name is "button"

1. If the [stack of open elements has a button element in scope](#), then run these substeps:
  1. [Parse error](#).
  2. [Generate implied end tags](#).
  3. Pop elements from the [stack of open elements](#) until a [button](#) element has been popped from the stack.
2. [Reconstruct the active formatting elements](#), if any.
3. [Insert an HTML element](#) for the token.
4. Set the [frameset-ok flag](#) to "not ok".

An end tag whose tag name is one of: "address", "article", "aside", "blockquote", "button", "center", "details", "dialog", "dir", "div", "dl", "fieldset", "figcaption", "figure", "footer", "header", "hgroup", "listing", "main", "menu", "nav", "ol", "pre", "section", "summary", "ul"

If the [stack of open elements](#) does not [have an element in scope](#) that is an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#); ignore the token.

Otherwise, run these steps:

1. [Generate implied end tags](#).
2. If the [current node](#) is not an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#).

3. Pop elements from the [stack of open elements](#) until an [HTML element](#) with the same tag name as the token has been popped from the stack.

An end tag whose tag name is "form"

If there is no [template](#) element on the [stack of open elements](#), then run these substeps:

1. Let *node* be the element that the [form element pointer](#) is set to, or null if it is not set to an element.
2. Set the [form element pointer](#) to null.
3. If *node* is null or if the [stack of open elements](#) does not [have node in scope](#), then this is a [parse error](#); return and ignore the token.
4. [Generate implied end tags](#).
5. If the [current node](#) is not *node*, then this is a [parse error](#).
6. Remove *node* from the [stack of open elements](#).

If there is a [template](#) element on the [stack of open elements](#), then run these substeps instead:

1. If the [stack of open elements](#) does not [have a form element in scope](#), then this is a [parse error](#); return and ignore the token.
2. [Generate implied end tags](#).
3. If the [current node](#) is not a [form](#) element, then this is a [parse error](#).
4. Pop elements from the [stack of open elements](#) until a [form](#) element has been popped from the stack.

An end tag whose tag name is "p"

If the [stack of open elements](#) does not [have a p element in button scope](#), then this is a [parse error](#); [insert an HTML element](#) for a "p" start tag token with no attributes.

[Close a p element](#).

An end tag whose tag name is "li"

If the [stack of open elements](#) does not [have an li element in list item scope](#), then this is a [parse error](#); ignore the token.

Otherwise, run these steps:

1. [Generate implied end tags](#), except for [li](#) elements.
2. If the [current node](#) is not an [li](#) element, then this is a [parse error](#).
3. Pop elements from the [stack of open elements](#) until an [li](#) element has been popped from the stack.

An end tag whose tag name is one of: "dd", "dt"

If the [stack of open elements](#) does not [have an element in scope](#) that is an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#); ignore the token.

Otherwise, run these steps:

1. [Generate implied end tags](#), except for [HTML elements](#) with the same tag name as the token.
2. If the [current node](#) is not an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#).
3. Pop elements from the [stack of open elements](#) until an [HTML element](#) with the same tag name as the token has been popped from the stack.

An end tag whose tag name is one of: "h1", "h2", "h3", "h4", "h5", "h6"

If the [stack of open elements](#) does not [have an element in scope](#) that is an [HTML element](#) and whose tag name is one of "h1", "h2", "h3", "h4", "h5", or "h6", then this is a [parse error](#); ignore the token.

Otherwise, run these steps:

1. [Generate implied end tags](#).
2. If the [current node](#) is not an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#).
3. Pop elements from the [stack of open elements](#) until an [HTML element](#) whose tag name is one of "h1", "h2", "h3", "h4", "h5", or "h6" has been popped from the stack.

An end tag whose tag name is "sarcasm"

Take a deep breath, then act as described in the "any other end tag" entry below.

A start tag whose tag name is "a"

If the [list of active formatting elements](#) contains an [a](#) element between the end of the list and the last [marker](#) on the list (or the start of the list if there is no [marker](#) on the list), then this is a [parse error](#); run the [adoption agency algorithm](#) for the token, then remove that

element from the [list of active formatting elements](#) and the [stack of open elements](#) if the [adoption agency algorithm](#) didn't already remove it (it might not have if the element is not in table scope).

In the non-conforming stream `<a href="a">a<table><a href="b">b</table>x`, the first [a](#) element would be closed upon seeing the second one, and the "x" character would be inside a link to "b", not to "a". This is despite the fact that the outer [a](#) element is not in table scope (meaning that a regular `</a>` end tag at the start of the table wouldn't close the outer [a](#) element). The result is that the two [a](#) elements are indirectly nested inside each other — non-conforming markup will often result in non-conforming DOMs when parsed.

[Reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token. [Push onto the list of active formatting elements](#) that element.

A start tag whose tag name is one of: "b", "big", "code", "em", "font", "i", "s", "small", "strike", "strong", "tt", "u"

[Reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token. [Push onto the list of active formatting elements](#) that element.

A start tag whose tag name is "nobr"

[Reconstruct the active formatting elements](#), if any.

If the [stack of open elements](#) has a [nobr](#) element in scope, then this is a [parse error](#); run the [adoption agency algorithm](#) for the token, then once again [reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token. [Push onto the list of active formatting elements](#) that element.

An end tag whose tag name is one of: "a", "b", "big", "code", "em", "font", "i", "nobr", "s", "small", "strike", "strong", "tt", "u"

Run the [adoption agency algorithm](#) for the token.

A start tag whose tag name is one of: "applet", "marquee", "object"

[Reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token.

Insert a [marker](#) at the end of the [list of active formatting elements](#).

Set the [frameset-ok flag](#) to "not ok".

An end tag token whose tag name is one of: "applet", "marquee", "object"

If the [stack of open elements](#) does not [have an element in scope](#) that is an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#); ignore the token.

Otherwise, run these steps:

1. [Generate implied end tags](#).
2. If the [current node](#) is not an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#).
3. Pop elements from the [stack of open elements](#) until an [HTML element](#) with the same tag name as the token has been popped from the stack.
4. [Clear the list of active formatting elements up to the last marker](#).

A start tag whose tag name is "table"

If the [Document](#) is *not* set to [quirks mode](#), and the [stack of open elements](#) [has a p element in button scope](#), then [close a p element](#).

[Insert an HTML element](#) for the token.

Set the [frameset-ok flag](#) to "not ok".

Switch the [insertion mode](#) to "[in table](#)".

An end tag whose tag name is "br"

[Parse error](#). Drop the attributes from the token, and act as described in the next entry; i.e. act as if this was a "br" start tag token with no attributes, rather than the end tag token that it actually is.

A start tag whose tag name is one of: "area", "br", "embed", "img", "keygen", "wbr"

[Reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token. Immediately pop the [current node](#) off the [stack of open elements](#).

[Acknowledge the token's self-closing flag](#), if it is set.

Set the [frameset-ok flag](#) to "not ok".

A start tag whose tag name is "input"

Reconstruct the active formatting elements, if any.

Insert an HTML element for the token. Immediately pop the current node off the stack of open elements.

Acknowledge the token's *self-closing flag*, if it is set.

If the token does not have an attribute with the name "type", or if it does, but that attribute's value is not an ASCII case-insensitive match for the string "**hidden**", then: set the frameset-ok flag to "not ok".

A start tag whose tag name is one of: "param", "source", "track"

Insert an HTML element for the token. Immediately pop the current node off the stack of open elements.

Acknowledge the token's *self-closing flag*, if it is set.

A start tag whose tag name is "hr"

If the stack of open elements has a **p** element in button scope, then close a p element.

Insert an HTML element for the token. Immediately pop the current node off the stack of open elements.

Acknowledge the token's *self-closing flag*, if it is set.

Set the frameset-ok flag to "not ok".

A start tag whose tag name is "image"

Parse error. Change the token's tag name to "img" and reprocess it. (Don't ask.)

A start tag whose tag name is "textarea"

Run these steps:

1. Insert an HTML element for the token.
2. If the next token is a U+000A LINE FEED (LF) character token, then ignore that token and move on to the next one. (Newlines at the start of textarea elements are ignored as an authoring convenience.)
3. Switch the tokenizer to the RCDATA state.
4. Let the original insertion mode be the current insertion mode.

5. Set the [frameset-ok flag](#) to "not ok".

6. Switch the [insertion mode](#) to "[text](#)".

A start tag whose tag name is "xmp"

If the [stack of open elements has a p element in button scope](#), then [close a p element](#).

[Reconstruct the active formatting elements](#), if any.

Set the [frameset-ok flag](#) to "not ok".

Follow the [generic raw text element parsing algorithm](#).

A start tag whose tag name is "iframe"

Set the [frameset-ok flag](#) to "not ok".

Follow the [generic raw text element parsing algorithm](#).

A start tag whose tag name is "noembed"

A start tag whose tag name is "noscript", if the [scripting flag](#) is enabled

Follow the [generic raw text element parsing algorithm](#).

A start tag whose tag name is "select"

[Reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token.

Set the [frameset-ok flag](#) to "not ok".

If the [insertion mode](#) is one of "[in table](#)", "[in caption](#)", "[in table body](#)", "[in row](#)", or "[in cell](#)", then switch the [insertion mode](#) to "[in select in table](#)". Otherwise, switch the [insertion mode](#) to "[in select](#)".

A start tag whose tag name is one of: "optgroup", "option"

If the [current node](#) is an [option](#) element, then pop the [current node](#) off the [stack of open elements](#).

[Reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token.

A start tag whose tag name is one of: "rb", "rtc"

If the [stack of open elements has a ruby element in scope](#), then [generate implied end tags](#). If the [current node](#) is not now a [ruby](#) element, this is a [parse error](#).

[Insert an HTML element](#) for the token.

A start tag whose tag name is one of: "rp", "rt"

If the [stack of open elements has a ruby element in scope](#), then [generate implied end tags](#), except for [rtc](#) elements. If the [current node](#) is not now a [rtc](#) element or a [ruby](#) element, this is a [parse error](#).

[Insert an HTML element](#) for the token.

A start tag whose tag name is "math"

[Reconstruct the active formatting elements](#), if any.

[Adjust MathML attributes](#) for the token. (This fixes the case of MathML attributes that are not all lowercase.)

[Adjust foreign attributes](#) for the token. (This fixes the use of namespaced attributes, in particular XLink.)

[Insert a foreign element](#) for the token, in the [MathML namespace](#).

If the token has its [self-closing flag](#) set, pop the [current node](#) off the [stack of open elements](#) and [acknowledge the token's self-closing flag](#).

A start tag whose tag name is "svg"

[Reconstruct the active formatting elements](#), if any.

[Adjust SVG attributes](#) for the token. (This fixes the case of SVG attributes that are not all lowercase.)

[Adjust foreign attributes](#) for the token. (This fixes the use of namespaced attributes, in particular XLink in SVG.)

[Insert a foreign element](#) for the token, in the [SVG namespace](#).

If the token has its [self-closing flag](#) set, pop the [current node](#) off the [stack of open elements](#) and [acknowledge the token's self-closing flag](#).

A start tag whose tag name is one of: "caption", "col", "colgroup", "frame", "head", "tbody", "td", "tfoot", "th", "thead", "tr"

[Parse error](#). Ignore the token.

Any other start tag

[Reconstruct the active formatting elements](#), if any.

[Insert an HTML element](#) for the token.

This element will be an [ordinary](#) element.

Any other end tag

Run these steps:

1. Initialize *node* to be the [current node](#) (the bottommost node of the stack).
2. *Loop*: If *node* is an [HTML element](#) with the same tag name as the token, then:
  1. [Generate implied end tags](#), except for [HTML elements](#) with the same tag name as the token.
  2. If *node* is not the [current node](#), then this is a [parse error](#).
  3. Pop all the nodes from the [current node](#) up to *node*, including *node*, then stop these steps.
3. Otherwise, if *node* is in the [special](#) category, then this is a [parse error](#); ignore the token, and return.
4. Set *node* to the previous entry in the [stack of open elements](#).
5. Return to the step labeled *loop*.

When the steps above say the user agent is to *close a p element*, it means that the user agent must run the following steps:

1. [Generate implied end tags](#), except for **p** elements.
2. If the [current node](#) is not a **p** element, then this is a [parse error](#).
3. Pop elements from the [stack of open elements](#) until a **p** element has been popped from the stack.

The *adoption agency algorithm*, which takes as its only argument a token *token* for which the algorithm is being run, consists of the following steps:

1. Let *subject* be *token*'s tag name.
2. If the *current node* is an [HTML element](#) whose tag name is *subject*, and the *current node* is not in the [list of active formatting elements](#), then pop the *current node* off the [stack of open elements](#) and return.
3. Let *outer loop counter* be 0.
4. While true:
  1. If *outer loop counter* is greater than or equal to 8, then return.
  2. Increment *outer loop counter* by 1.
  3. Let *formatting element* be the last element in the [list of active formatting elements](#) that:
    - is between the end of the list and the last [marker](#) in the list, if any, or the start of the list otherwise, and
    - has the tag name *subject*.
 If there is no such element, then return and instead act as described in the "any other end tag" entry above.
  4. If *formatting element* is not in the [stack of open elements](#), then this is a [parse error](#); remove the element from the list, and return.
  5. If *formatting element* is in the [stack of open elements](#), but the element is not [in scope](#), then this is a [parse error](#); return.
  6. If *formatting element* is not the [current node](#), this is a [parse error](#). (But do not return.)
  7. Let *furthest block* be the topmost node in the [stack of open elements](#) that is lower in the stack than *formatting element*, and is an element in the [special](#) category. There might not be one.
  8. If there is no *furthest block*, then the UA must first pop all the nodes from the bottom of the [stack of open elements](#), from the [current node](#) up to and including *formatting element*, then remove *formatting element* from the [list of active formatting elements](#), and finally return.
  9. Let *common ancestor* be the element immediately above *formatting element* in the [stack of open elements](#).
  10. Let a bookmark note the position of *formatting element* in the [list of active formatting elements](#) relative to the elements on either side of it in the list.

11. Let *node* and *last node* be *furthest block*.
12. Let *inner loop counter* be 0.
13. While true:
  1. Increment *inner loop counter* by 1.
  2. Let *node* be the element immediately above *node* in the [stack of open elements](#), or if *node* is no longer in the [stack of open elements](#) (e.g. because it got removed by this algorithm), the element that was immediately above *node* in the [stack of open elements](#) before *node* was removed.
  3. If *node* is *formatting element*, then [break](#).
  4. If *inner loop counter* is greater than 3 and *node* is in the [list of active formatting elements](#), then remove *node* from the [list of active formatting elements](#).
  5. If *node* is not in the [list of active formatting elements](#), then remove *node* from the [stack of open elements](#) and [continue](#).
  6. [Create an element for the token](#) for which the element *node* was created, in the [HTML namespace](#), with *common ancestor* as the intended parent; replace the entry for *node* in the [list of active formatting elements](#) with an entry for the new element, replace the entry for *node* in the [stack of open elements](#) with an entry for the new element, and let *node* be the new element.
  7. If *last node* is *furthest block*, then move the aforementioned bookmark to be immediately after the new *node* in the [list of active formatting elements](#).
  8. [Append](#) *last node* to *node*.
  9. Set *last node* to *node*.
14. Insert whatever *last node* ended up being in the previous step at the [appropriate place for inserting a node](#), but using *common ancestor* as the *override target*.
15. [Create an element for the token](#) for which *formatting element* was created, in the [HTML namespace](#), with *furthest block* as the intended parent.
16. Take all of the child nodes of *furthest block* and append them to the element created in the last step.
17. Append that new element to *furthest block*.

18. Remove *formatting element* from the [list of active formatting elements](#), and insert the new element into the [list of active formatting elements](#) at the position of the aforementioned bookmark.
19. Remove *formatting element* from the [stack of open elements](#), and insert the new element into the [stack of open elements](#) immediately below the position of *furthest block* in that stack.

This algorithm's name, the "adoption agency algorithm", comes from the way it causes elements to change parents, and is in contrast with [other possible algorithms](#) for dealing with misnested content.

#### 13.2.6.4.8 The "text" insertion mode

When the user agent is to apply the rules for the "[text](#)" [insertion mode](#), the user agent must handle the token as follows:

##### A character token

[Insert the token's character.](#)

This can never be a U+0000 NULL character; the tokenizer converts those to U+FFFD REPLACEMENT CHARACTER characters.

##### An end-of-file token

[Parse error.](#)

If the [current node](#) is a [script](#) element, mark the [script](#) element as "[already started](#)".

Pop the [current node](#) off the [stack of open elements](#).

Switch the [insertion mode](#) to the [original insertion mode](#) and reprocess the token.

##### An end tag whose tag name is "script"

If the [active speculative HTML parser](#) is null and the [JavaScript execution context stack](#) is empty, then [perform a microtask checkpoint](#).

Let *script* be the [current node](#) (which will be a [script](#) element).

Pop the [current node](#) off the [stack of open elements](#).

Switch the [insertion mode](#) to the [original insertion mode](#).

Let the *old insertion point* have the same value as the current [insertion point](#). Let the [insertion point](#) be just before the [next input character](#).

Increment the parser's [script nesting level](#) by one.

If the [active speculative HTML parser](#) is null, then [prepare](#) the *script*. This might cause some script to execute, which might cause [new characters to be inserted into the tokenizer](#), and might cause the tokenizer to output more tokens, resulting in a [reentrant invocation of the parser](#).

Decrement the parser's [script nesting level](#) by one. If the parser's [script nesting level](#) is zero, then set the [parser pause flag](#) to false.

Let the [insertion point](#) have the value of the *old insertion point*. (In other words, restore the [insertion point](#) to its previous value. This value might be the "undefined" value.)

At this stage, if there is a [pending parsing-blocking script](#), then:

If the [script nesting level](#) is not zero:

Set the [parser pause flag](#) to true, and abort the processing of any nested invocations of the tokenizer, yielding control back to the caller. (Tokenization will resume when the caller returns to the "outer" tree construction stage.)

The tree construction stage of this particular parser is [being called reentrantly](#), say from a call to [document.write\(\)](#).

Otherwise:

Run these steps:

1. Let *the script* be the [pending parsing-blocking script](#). There is no longer a [pending parsing-blocking script](#).
2. [Start the speculative HTML parser](#) for this instance of the HTML parser.
3. Block the [tokenizer](#) for this instance of the [HTML parser](#), such that the [event loop](#) will not run [tasks](#) that invoke the [tokenizer](#).
4. If the parser's [Document has a style sheet that is blocking scripts](#) or *the script's "ready to be parser-executed"* flag is not set: [spin the event loop](#) until the parser's [Document has no style sheet that is blocking scripts](#) and *the script's "ready to be parser-executed"* flag is set.
5. If this [parser has been aborted](#) in the meantime, return.

This could happen if, e.g., while the [spin the event loop](#) algorithm is running, the [browsing context](#) gets closed, or the [document.open\(\)](#) method gets invoked on the [Document](#).

6. [Stop the speculative HTML parser](#) for this instance of the HTML parser.

7. Unblock the [tokenizer](#) for this instance of the [HTML parser](#), such that [tasks](#) that invoke the [tokenizer](#) can again be run.
8. Let the [insertion point](#) be just before the [next input character](#).
9. Increment the parser's [script nesting level](#) by one (it should be zero before this step, so this sets it to one).
10. [Execute the script](#).
11. Decrement the parser's [script nesting level](#) by one. If the parser's [script nesting level](#) is zero (which it always should be at this point), then set the [parser pause flag](#) to false.
12. Let the [insertion point](#) be undefined again.
13. If there is once again a [pending parsing-blocking script](#), then repeat these steps from step 1.

## Any other end tag

Pop the [current node](#) off the [stack of open elements](#).

Switch the [insertion mode](#) to the [original insertion mode](#).

### 13.2.6.4.9 The "in table" insertion mode

When the user agent is to apply the rules for the "[in table](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token, if the [current node](#) is [table](#), [tbody](#), [tfoot](#), [thead](#), or [tr](#) element

Let the *pending table character tokens* be an empty list of tokens.

Let the [original insertion mode](#) be the current [insertion mode](#).

Switch the [insertion mode](#) to "[in table text](#)" and reprocess the token.

## A comment token

[Insert a comment](#).

## A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "caption"

[Clear the stack back to a table context.](#) (See below.)

Insert a [marker](#) at the end of the [list of active formatting elements](#).

[Insert an HTML element](#) for the token, then switch the [insertion mode](#) to "[in caption](#)".

A start tag whose tag name is "colgroup"

[Clear the stack back to a table context.](#) (See below.)

[Insert an HTML element](#) for the token, then switch the [insertion mode](#) to "[in column group](#)".

A start tag whose tag name is "col"

[Clear the stack back to a table context.](#) (See below.)

[Insert an HTML element](#) for a "colgroup" start tag token with no attributes, then switch the [insertion mode](#) to "[in column group](#)".

Reprocess the current token.

A start tag whose tag name is one of: "tbody", "tfoot", "thead"

[Clear the stack back to a table context.](#) (See below.)

[Insert an HTML element](#) for the token, then switch the [insertion mode](#) to "[in table body](#)".

A start tag whose tag name is one of: "td", "th", "tr"

[Clear the stack back to a table context.](#) (See below.)

[Insert an HTML element](#) for a "tbody" start tag token with no attributes, then switch the [insertion mode](#) to "[in table body](#)".

Reprocess the current token.

A start tag whose tag name is "table"

[Parse error.](#)

If the [stack of open elements](#) does not [have a table element in table scope](#), ignore the token.

Otherwise:

Pop elements from this stack until a **table** element has been popped from the stack.

Reset the insertion mode appropriately.

Reprocess the token.

An end tag whose tag name is "table"

If the [stack of open elements](#) does not [have a \*\*table\*\* element in table scope](#), this is a [parse error](#); ignore the token.

Otherwise:

Pop elements from this stack until a **table** element has been popped from the stack.

Reset the insertion mode appropriately.

An end tag whose tag name is one of: "body", "caption", "col", "colgroup", "html", "tbody", "td", "tfoot", "th", "thead", "tr"

[Parse error](#). Ignore the token.

A start tag whose tag name is one of: "style", "script", "template"

An end tag whose tag name is "template"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

A start tag whose tag name is "input"

If the token does not have an attribute with the name "type", or if it does, but that attribute's value is not an [ASCII case-insensitive](#) match for the string "**hidden**", then: act as described in the "anything else" entry below.

Otherwise:

[Parse error](#).

[Insert an HTML element](#) for the token.

Pop that **input** element off the [stack of open elements](#).

[Acknowledge the token's \*self-closing flag\*](#), if it is set.

A start tag whose tag name is "form"

[Parse error](#).

If there is a **template** element on the [stack of open elements](#), or if the **form** element

[pointer](#) is not null, ignore the token.

Otherwise:

[Insert an HTML element](#) for the token, and set the [form element pointer](#) to point to the element created.

Pop that [form](#) element off the [stack of open elements](#).

An end-of-file token

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

Anything else

[Parse error](#). Enable [foster parenting](#), process the token [using the rules for](#) the "[in body](#)" [insertion mode](#), and then disable [foster parenting](#).

When the steps above require the UA to *clear the stack back to a table context*, it means that the UA must, while the [current node](#) is not a [table](#), [template](#), or [html](#) element, pop elements from the [stack of open elements](#).

This is the same list of elements as used in the [has an element in table scope](#) steps.

The [current node](#) being an [html](#) element after this process is a [fragment case](#).

#### 13.2.6.4.10 The "[in table text](#)" insertion mode

When the user agent is to apply the rules for the "[in table text](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is U+0000 NULL

[Parse error](#). Ignore the token.

Any other character token

Append the character token to the [pending table character tokens](#) list.

Anything else

If any of the tokens in the [pending table character tokens](#) list are character tokens that are not [ASCII whitespace](#), then this is a [parse error](#): reprocess the character tokens in the [pending table character tokens](#) list using the rules given in the "anything else" entry in the "[in table](#)" insertion mode.

Otherwise, [insert the characters](#) given by the [pending table character tokens](#) list.

Switch the [insertion mode](#) to the [original insertion mode](#) and reprocess the token.

#### 13.2.6.4.11 The "*in caption*" insertion mode

When the user agent is to apply the rules for the "[in caption](#)" [insertion mode](#), the user agent must handle the token as follows:

An end tag whose tag name is "caption"

If the [stack of open elements](#) does not [have a caption element in table scope](#), this is a [parse error](#); ignore the token. ([fragment case](#))

Otherwise:

[Generate implied end tags.](#)

Now, if the [current node](#) is not a [caption](#) element, then this is a [parse error](#).

Pop elements from this stack until a [caption](#) element has been popped from the stack.

[Clear the list of active formatting elements up to the last marker.](#)

Switch the [insertion mode](#) to "[in table](#)".

A start tag whose tag name is one of: "caption", "col", "colgroup", "tbody", "td", "tfoot", "th", "thead", "tr"

An end tag whose tag name is "table"

If the [stack of open elements](#) does not [have a caption element in table scope](#), this is a [parse error](#); ignore the token. ([fragment case](#))

Otherwise:

[Generate implied end tags.](#)

Now, if the [current node](#) is not a [caption](#) element, then this is a [parse error](#).

Pop elements from this stack until a [caption](#) element has been popped from the stack.

[Clear the list of active formatting elements up to the last marker.](#)

Switch the [insertion mode](#) to "[in table](#)".

Reprocess the token.

An end tag whose tag name is one of: "body", "col", "colgroup", "html", "tbody", "td", "tfoot", "th", "thead", "tr"

[Parse error](#). Ignore the token.

Anything else

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

13.2.6.4.12 The "*in column group*" insertion mode

When the user agent is to apply the rules for the "[in column group](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

[Insert the character](#).

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

A start tag whose tag name is "col"

[Insert an HTML element](#) for the token. Immediately pop the [current node](#) off the [stack of open elements](#).

[Acknowledge the token's \*self-closing flag\*](#), if it is set.

An end tag whose tag name is "colgroup"

If the [current node](#) is not a [colgroup](#) element, then this is a [parse error](#); ignore the token.

Otherwise, pop the [current node](#) from the [stack of open elements](#). Switch the [insertion mode](#) to "[in table](#)".

An end tag whose tag name is "col"

[Parse error](#). Ignore the token.

A start tag whose tag name is "template"  
An end tag whose tag name is "template"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

An end-of-file token

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

Anything else

If the [current node](#) is not a [colgroup](#) element, then this is a [parse error](#); ignore the token.

Otherwise, pop the [current node](#) from the [stack of open elements](#).

Switch the [insertion mode](#) to "[in table](#)".

Reprocess the token.

#### 13.2.6.4.13 The "[in table body](#)" [insertion mode](#)

When the user agent is to apply the rules for the "[in table body](#)" [insertion mode](#), the user agent must handle the token as follows:

A start tag whose tag name is "tr"

[Clear the stack back to a table body context](#). (See below.)

[Insert an HTML element](#) for the token, then switch the [insertion mode](#) to "[in row](#)".

A start tag whose tag name is one of: "th", "td"

[Parse error](#).

[Clear the stack back to a table body context](#). (See below.)

[Insert an HTML element](#) for a "tr" start tag token with no attributes, then switch the [insertion mode](#) to "[in row](#)".

Reprocess the current token.

An end tag whose tag name is one of: "tbody", "tfoot", "thead"

If the [stack of open elements](#) does not [have an element in table scope](#) that is an [HTML element](#) with the same tag name as the token, this is a [parse error](#); ignore the token.

Otherwise:

[Clear the stack back to a table body context.](#) (See below.)

Pop the [current node](#) from the [stack of open elements](#). Switch the [insertion mode](#) to "[in table](#)".

A start tag whose tag name is one of: "caption", "col", "colgroup", "tbody", "tfoot", "thead"  
An end tag whose tag name is "table"

If the [stack of open elements](#) does not [have a tbody, thead, or tfoot element in table scope](#), this is a [parse error](#); ignore the token.

Otherwise:

[Clear the stack back to a table body context.](#) (See below.)

Pop the [current node](#) from the [stack of open elements](#). Switch the [insertion mode](#) to "[in table](#)".

Reprocess the token.

An end tag whose tag name is one of: "body", "caption", "col", "colgroup", "html", "td", "th", "tr"

[Parse error](#). Ignore the token.

Anything else

Process the token [using the rules for](#) the "[in table](#)" [insertion mode](#).

When the steps above require the UA to *clear the stack back to a table body context*, it means that the UA must, while the [current node](#) is not a [tbody](#), [tfoot](#), [thead](#), [template](#), or [html](#) element, pop elements from the [stack of open elements](#).

The [current node](#) being an [html](#) element after this process is a [fragment case](#).

#### 13.2.6.4.14 The "[in row](#)" insertion mode

When the user agent is to apply the rules for the "[in row](#)" [insertion mode](#), the user agent must handle the token as follows:

A start tag whose tag name is one of: "th", "td"

[Clear the stack back to a table row context.](#) (See below.)

[Insert an HTML element](#) for the token, then switch the [insertion mode](#) to "[in cell](#)".

Insert a [marker](#) at the end of the [list of active formatting elements](#).

An end tag whose tag name is "tr"

If the [stack of open elements](#) does not [have a tr element in table scope](#), this is a [parse error](#); ignore the token.

Otherwise:

[Clear the stack back to a table row context](#). (See below.)

Pop the [current node](#) (which will be a [tr](#) element) from the [stack of open elements](#). Switch the [insertion mode](#) to "[in table body](#)".

A start tag whose tag name is one of: "caption", "col", "colgroup", "tbody", "tfoot", "thead", "tr"  
An end tag whose tag name is "table"

If the [stack of open elements](#) does not [have a tr element in table scope](#), this is a [parse error](#); ignore the token.

Otherwise:

[Clear the stack back to a table row context](#). (See below.)

Pop the [current node](#) (which will be a [tr](#) element) from the [stack of open elements](#). Switch the [insertion mode](#) to "[in table body](#)".

Reprocess the token.

An end tag whose tag name is one of: "tbody", "tfoot", "thead"

If the [stack of open elements](#) does not [have an element in table scope](#) that is an [HTML element](#) with the same tag name as the token, this is a [parse error](#); ignore the token.

If the [stack of open elements](#) does not [have a tr element in table scope](#), ignore the token.

Otherwise:

[Clear the stack back to a table row context](#). (See below.)

Pop the [current node](#) (which will be a [tr](#) element) from the [stack of open elements](#). Switch the [insertion mode](#) to "[in table body](#)".

Reprocess the token.

An end tag whose tag name is one of: "body", "caption", "col", "colgroup", "html", "td", "th"

[Parse error](#). Ignore the token.

Anything else

Process the token [using the rules for the "in table" insertion mode](#).

When the steps above require the UA to *clear the stack back to a table row context*, it means that the UA must, while the [current node](#) is not a [tr](#), [template](#), or [html](#) element, pop elements from the [stack of open elements](#).

The [current node](#) being an [html](#) element after this process is a [fragment case](#).

#### 13.2.6.4.15 The "in cell" insertion mode

When the user agent is to apply the rules for the ["in cell" insertion mode](#), the user agent must handle the token as follows:

An end tag whose tag name is one of: "td", "th"

If the [stack of open elements](#) does not [have an element in table scope](#) that is an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#); ignore the token.

Otherwise:

[Generate implied end tags](#).

Now, if the [current node](#) is not an [HTML element](#) with the same tag name as the token, then this is a [parse error](#).

Pop elements from the [stack of open elements](#) stack until an [HTML element](#) with the same tag name as the token has been popped from the stack.

[Clear the list of active formatting elements up to the last marker](#).

Switch the [insertion mode](#) to ["in row"](#).

A start tag whose tag name is one of: "caption", "col", "colgroup", "tbody", "td", "tfoot", "th", "thead", "tr"

If the [stack of open elements](#) does not [have a td or th element in table scope](#), then this is a [parse error](#); ignore the token. ([fragment case](#))

Otherwise, [close the cell](#) (see below) and reprocess the token.

An end tag whose tag name is one of: "body", "caption", "col", "colgroup", "html"

[Parse error](#). Ignore the token.

An end tag whose tag name is one of: "table", "tbody", "tfoot", "thead", "tr"

If the [stack of open elements](#) does not [have an element in table scope](#) that is an [HTML element](#) with the same tag name as that of the token, then this is a [parse error](#); ignore the token.

Otherwise, [close the cell](#) (see below) and reprocess the token.

Anything else

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

Where the steps above say to *close the cell*, they mean to run the following algorithm:

1. [Generate implied end tags](#).
2. If the [current node](#) is not now a [td](#) element or a [th](#) element, then this is a [parse error](#).
3. Pop elements from the [stack of open elements](#) stack until a [td](#) element or a [th](#) element has been popped from the stack.
4. [Clear the list of active formatting elements up to the last marker](#).
5. Switch the [insertion mode](#) to "[in row](#)".

The [stack of open elements](#) cannot have both a [td](#) and a [th](#) element [in table scope](#) at the same time, nor can it have neither when the [close the cell](#) algorithm is invoked.

#### 13.2.6.4.16 The "[in select](#)" insertion mode

When the user agent is to apply the rules for the "[in select](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is U+0000 NULL

[Parse error](#). Ignore the token.

Any other character token

[Insert the token's character](#).

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for the "in body" insertion mode](#).

A start tag whose tag name is "option"

If the [current node](#) is an [option](#) element, pop that node from the [stack of open elements](#).

[Insert an HTML element](#) for the token.

A start tag whose tag name is "optgroup"

If the [current node](#) is an [option](#) element, pop that node from the [stack of open elements](#).

If the [current node](#) is an [optgroup](#) element, pop that node from the [stack of open elements](#).

[Insert an HTML element](#) for the token.

An end tag whose tag name is "optgroup"

First, if the [current node](#) is an [option](#) element, and the node immediately before it in the [stack of open elements](#) is an [optgroup](#) element, then pop the [current node](#) from the [stack of open elements](#).

If the [current node](#) is an [optgroup](#) element, then pop that node from the [stack of open elements](#). Otherwise, this is a [parse error](#); ignore the token.

An end tag whose tag name is "option"

If the [current node](#) is an [option](#) element, then pop that node from the [stack of open elements](#). Otherwise, this is a [parse error](#); ignore the token.

An end tag whose tag name is "select"

If the [stack of open elements](#) does not [have a select element in select scope](#), this is a [parse error](#); ignore the token. ([fragment case](#))

Otherwise:

Pop elements from the [stack of open elements](#) until a [select](#) element has been popped from the stack.

[Reset the insertion mode appropriately](#).

A start tag whose tag name is "select"

[Parse error](#).

If the [stack of open elements](#) does not [have a `select` element in select scope](#), ignore the token. ([fragment case](#))

Otherwise:

Pop elements from the [stack of open elements](#) until a [`select`](#) element has been popped from the stack.

[Reset the insertion mode appropriately.](#)

It just gets treated like an end tag.

A start tag whose tag name is one of: "input", "keygen", "textarea"

[Parse error.](#)

If the [stack of open elements](#) does not [have a `select` element in select scope](#), ignore the token. ([fragment case](#))

Otherwise:

Pop elements from the [stack of open elements](#) until a [`select`](#) element has been popped from the stack.

[Reset the insertion mode appropriately.](#)

Reprocess the token.

A start tag whose tag name is one of: "script", "template"

An end tag whose tag name is "template"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

An end-of-file token

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

Anything else

[Parse error.](#) Ignore the token.

13.2.6.4.17 The "*in select in table*" insertion mode

When the user agent is to apply the rules for the "[in select in table](#)" [insertion mode](#), the user agent must handle the token as follows:

A start tag whose tag name is one of: "caption", "table", "tbody", "tfoot", "thead", "tr", "td", "th"

[Parse error.](#)

Pop elements from the [stack of open elements](#) until a [select](#) element has been popped from the stack.

[Reset the insertion mode appropriately.](#)

Reprocess the token.

An end tag whose tag name is one of: "caption", "table", "tbody", "tfoot", "thead", "tr", "td", "th"

[Parse error.](#)

If the [stack of open elements](#) does not [have an element in table scope](#) that is an [HTML element](#) with the same tag name as that of the token, then ignore the token.

Otherwise:

Pop elements from the [stack of open elements](#) until a [select](#) element has been popped from the stack.

[Reset the insertion mode appropriately.](#)

Reprocess the token.

Anything else

Process the token [using the rules for](#) the "[in select](#)" [insertion mode](#).

#### 13.2.6.4.18 The "*in template*" insertion mode

When the user agent is to apply the rules for the "[in template](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token

A comment token

A DOCTYPE token

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

A start tag whose tag name is one of: "base", "basefont", "bgsound", "link", "meta", "noframes", "script", "style", "template", "title"

An end tag whose tag name is "template"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

A start tag whose tag name is one of: "caption", "colgroup", "tbody", "tfoot", "thead"

Pop the [current template insertion mode](#) off the [stack of template insertion modes](#).

Push "[in table](#)" onto the [stack of template insertion modes](#) so that it is the new [current template insertion mode](#).

Switch the [insertion mode](#) to "[in table](#)", and reprocess the token.

A start tag whose tag name is "col"

Pop the [current template insertion mode](#) off the [stack of template insertion modes](#).

Push "[in column group](#)" onto the [stack of template insertion modes](#) so that it is the new [current template insertion mode](#).

Switch the [insertion mode](#) to "[in column group](#)", and reprocess the token.

A start tag whose tag name is "tr"

Pop the [current template insertion mode](#) off the [stack of template insertion modes](#).

Push "[in table body](#)" onto the [stack of template insertion modes](#) so that it is the new [current template insertion mode](#).

Switch the [insertion mode](#) to "[in table body](#)", and reprocess the token.

A start tag whose tag name is one of: "td", "th"

Pop the [current template insertion mode](#) off the [stack of template insertion modes](#).

Push "[in row](#)" onto the [stack of template insertion modes](#) so that it is the new [current template insertion mode](#).

Switch the [insertion mode](#) to "[in row](#)", and reprocess the token.

Any other start tag

Pop the [current template insertion mode](#) off the [stack of template insertion modes](#).

Push "[in body](#)" onto the [stack of template insertion modes](#) so that it is the new [current template insertion mode](#).

Switch the [insertion mode](#) to "[in body](#)", and reprocess the token.

Any other end tag

[Parse error](#). Ignore the token.

## An end-of-file token

If there is no [template](#) element on the [stack of open elements](#), then [stop parsing](#). ([fragment case](#))

Otherwise, this is a [parse error](#).

Pop elements from the [stack of open elements](#) until a [template](#) element has been popped from the stack.

[Clear the list of active formatting elements up to the last marker](#).

Pop the [current template insertion mode](#) off the [stack of template insertion modes](#).

[Reset the insertion mode appropriately](#).

Reprocess the token.

### 13.2.6.4.19 The "after body" insertion mode

When the user agent is to apply the rules for the "[after body](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

## A comment token

[Insert a comment](#) as the last child of the first element in the [stack of open elements](#) (the [html](#) element).

## A DOCTYPE token

[Parse error](#). Ignore the token.

## A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

## An end tag whose tag name is "html"

If the parser was created as part of the [HTML fragment parsing algorithm](#), this is a [parse error](#); ignore the token. ([fragment case](#))

Otherwise, switch the [insertion mode](#) to "[after after body](#)".

An end-of-file token

[Stop parsing.](#)

Anything else

[Parse error](#). Switch the [insertion mode](#) to "in body" and reprocess the token.

13.2.6.4.20 The "*in frameset*" insertion mode

When the user agent is to apply the rules for the "[in frameset](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

[Insert the character.](#)

A comment token

[Insert a comment.](#)

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

A start tag whose tag name is "frameset"

[Insert an HTML element](#) for the token.

An end tag whose tag name is "frameset"

If the [current node](#) is the root [html](#) element, then this is a [parse error](#); ignore the token. ([fragment case](#))

Otherwise, pop the [current node](#) from the [stack of open elements](#).

If the parser was not created as part of the [HTML fragment parsing algorithm \(fragment case\)](#), and the [current node](#) is no longer a [frameset](#) element, then switch the [insertion mode](#) to "after frameset".

A start tag whose tag name is "frame"

[Insert an HTML element](#) for the token. Immediately pop the [current node](#) off the [stack of](#)

[open elements](#).

[Acknowledge the token's \*self-closing flag\*](#), if it is set.

A start tag whose tag name is "noframes"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

An end-of-file token

If the [current node](#) is not the root [html](#) element, then this is a [parse error](#).

The [current node](#) can only be the root [html](#) element in the [fragment case](#).

[Stop parsing](#).

Anything else

[Parse error](#). Ignore the token.

13.2.6.4.21 The "*after frameset*" insertion mode

When the user agent is to apply the rules for the "[after frameset](#)" [insertion mode](#), the user agent must handle the token as follows:

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

[Insert the character](#).

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

An end tag whose tag name is "html"

Switch the [insertion mode](#) to "[after after frameset](#)".

A start tag whose tag name is "noframes"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

An end-of-file token

[Stop parsing](#).

Anything else

[Parse error](#). Ignore the token.

13.2.6.4.22 The "*after after body*" insertion mode

When the user agent is to apply the rules for the "[after after body](#)" [insertion mode](#), the user agent must handle the token as follows:

A comment token

[Insert a comment](#) as the last child of the [Document](#) object.

A DOCTYPE token

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

An end-of-file token

[Stop parsing](#).

Anything else

[Parse error](#). Switch the [insertion mode](#) to "[in body](#)" and reprocess the token.

13.2.6.4.23 The "*after after frameset*" insertion mode

When the user agent is to apply the rules for the "[after after frameset](#)" [insertion mode](#), the user agent must handle the token as follows:

A comment token

[Insert a comment](#) as the last child of the [Document](#) object.

A DOCTYPE token

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED

(LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE  
A start tag whose tag name is "html"

Process the token [using the rules for](#) the "[in body](#)" [insertion mode](#).

An end-of-file token

[Stop parsing](#).

A start tag whose tag name is "noframes"

Process the token [using the rules for](#) the "[in head](#)" [insertion mode](#).

Anything else

[Parse error](#). Ignore the token.

#### 13.2.6.5 The rules for parsing tokens *in foreign content*

When the user agent is to apply the rules for parsing tokens in foreign content, the user agent must handle the token as follows:

A character token that is U+0000 NULL

[Parse error](#). [Insert a U+FFFD REPLACEMENT CHARACTER character](#).

A character token that is one of U+0009 CHARACTER TABULATION, U+000A LINE FEED (LF), U+000C FORM FEED (FF), U+000D CARRIAGE RETURN (CR), or U+0020 SPACE

[Insert the token's character](#).

Any other character token

[Insert the token's character](#).

Set the [frameset-ok flag](#) to "not ok".

A comment token

[Insert a comment](#).

A DOCTYPE token

[Parse error](#). Ignore the token.

A start tag whose tag name is one of: "b", "big", "blockquote", "body", "br", "center", "code", "dd", "div", "dl", "dt", "em", "embed", "h1", "h2", "h3", "h4", "h5", "h6", "head", "hr", "i", "img", "li", "listing", "menu", "meta", "nobr", "ol", "p", "pre", "ruby", "s", "small", "span", "strong", "strike",

"sub", "sup", "table", "tt", "u", "ul", "var"

A start tag whose tag name is "font", if the token has any attributes named "color", "face", or "size"

An end tag whose tag name is "br", "p"

#### Parse error.

While the [current node](#) is not a [MathML text integration point](#), an [HTML integration point](#), or an element in the [HTML namespace](#), pop elements from the [stack of open elements](#).

Reprocess the token according to the rules given in the section corresponding to the current [insertion mode](#) in HTML content.

Any other start tag

If the [adjusted current node](#) is an element in the [MathML namespace](#), [adjust MathML attributes](#) for the token. (This fixes the case of MathML attributes that are not all lowercase.)

If the [adjusted current node](#) is an element in the [SVG namespace](#), and the token's tag name is one of the ones in the first column of the following table, change the tag name to the name given in the corresponding cell in the second column. (This fixes the case of SVG elements that are not all lowercase.)

Tag name	Element name
altglyph	altGlyph
altglyphdef	altGlyphDef
altglyphitem	altGlyphItem
animatecolor	animateColor
animatemotion	animateMotion
animatetransform	animateTransform
clippath	clipPath
feblend	feBlend
fecolormatrix	feColorMatrix
fecomponenttransfer	feComponentTransfer
fecomposite	feComposite
feconvolvematrix	feConvolveMatrix
fediffuselighting	feDiffuseLighting
fedisplacementmap	feDisplacementMap
fedistantlight	feDistantLight
fedropshadow	feDropShadow
feflood	feFlood
fefunca	feFuncA
fefuncb	feFuncB

Tag name	Element name
fefuncg	feFuncG
fefuncr	feFuncR
fegaussianblur	feGaussianBlur
feimage	feImage
femerge	feMerge
femergenode	feMergeNode
femorphology	feMorphology
feoffset	feOffset
fepointlight	fePointLight
fespecularlighting	feSpecularLighting
fespotlight	feSpotLight
fetile	feTile
feturbulence	feTurbulence
foreignobject	foreignObject
glyphref	glyphRef
lineargradient	linearGradient
radialgradient	radialGradient
textpath	textPath

If the [adjusted current node](#) is an element in the [SVG namespace](#), [adjust SVG attributes](#) for the token. (This fixes the case of SVG attributes that are not all lowercase.)

[Adjust foreign attributes](#) for the token. (This fixes the use of namespaced attributes, in particular XLink in SVG.)

[Insert a foreign element](#) for the token, in the same namespace as the [adjusted current node](#).

If the token has its [\*self-closing flag\*](#) set, then run the appropriate steps from the following list:

If the token's tag name is "script", and the new [current node](#) is in the [SVG namespace](#)

[Acknowledge the token's \*self-closing flag\*](#), and then act as described in the steps for a "script" end tag below.

Otherwise

Pop the [current node](#) off the [stack of open elements](#) and [acknowledge the token's \*self-closing flag\*](#).

An end tag whose tag name is "script", if the [current node](#) is an [SVG script](#) element

Pop the [current node](#) off the [stack of open elements](#).

Let the *old insertion point* have the same value as the current [insertion point](#). Let the [insertion point](#) be just before the [next input character](#).

Increment the parser's [script nesting level](#) by one. Set the [parser pause flag](#) to true.

If the [active speculative HTML parser](#) is null and the user agent supports SVG, then [Process the SVG script element](#) according to the SVG rules. [\[SVG\]](#)

Even if this causes [new characters to be inserted into the tokenizer](#), the parser will not be executed reentrantly, since the [parser pause flag](#) is true.

Decrement the parser's [script nesting level](#) by one. If the parser's [script nesting level](#) is zero, then set the [parser pause flag](#) to false.

Let the [insertion point](#) have the value of the *old insertion point*. (In other words, restore the [insertion point](#) to its previous value. This value might be the "undefined" value.)

### Any other end tag

Run these steps:

1. Initialize *node* to be the [current node](#) (the bottommost node of the stack).
2. If *node*'s tag name, [converted to ASCII lowercase](#), is not the same as the tag name of the token, then this is a [parse error](#).
3. *Loop*: If *node* is the topmost element in the [stack of open elements](#), then return. ([fragment case](#))
4. If *node*'s tag name, [converted to ASCII lowercase](#), is the same as the tag name of the token, pop elements from the [stack of open elements](#) until *node* has been popped from the stack, and then return.
5. Set *node* to the previous entry in the [stack of open elements](#).
6. If *node* is not an element in the [HTML namespace](#), return to the step labeled *loop*.
7. Otherwise, process the token according to the rules given in the section corresponding to the current [insertion mode](#) in HTML content.

#### 13.2.7 The end



[Document/DOMContentLoaded\\_event](#)

Support in all current engines.

Firefox 1+ Safari 3.1+ Chrome 1+

---

Opera 9+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 9+

---

Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

Once the user agent *stops parsing* the document, the user agent must run the following steps:



## [Window/load\\_event](#)

Support in all current engines.

Firefox 1+ Safari 1.3+ Chrome 1+

---

Opera 4+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 4+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 10.1+

1. If the [active speculative HTML parser](#) is not null, then [stop the speculative HTML parser](#) and return.
2. Set the [insertion point](#) to undefined.
3. [Update the current document readiness](#) to "interactive".
4. Pop *all* the nodes off the [stack of open elements](#).
5. While the [list of scripts that will execute when the document has finished parsing](#) is not empty:
  1. [Spin the event loop](#) until the first [script](#) in the [list of scripts that will execute when the document has finished parsing](#) has its "[ready to be parser-executed](#)" flag set and the parser's [Document](#) has no style sheet that is blocking scripts.
  2. [Execute](#) the first [script](#) in the [list of scripts that will execute when the document has finished parsing](#).
  3. Remove the first [script](#) element from the [list of scripts that will execute when the document has finished parsing](#) (i.e. shift out the first entry in the list).
6. [Queue a global task](#) on the [DOM manipulation task source](#) given the [Document](#)'s relevant global object to run the following substeps:
  1. Set the [Document](#)'s [load timing info](#)'s [DOM content loaded event start time](#) to

- the [current high resolution time](#) given the [Document](#)'s [relevant global object](#).
2. Fire an event named [DOMContentLoaded](#) at the [Document](#) object, with its [bubbles](#) attribute initialized to true.
  3. Set the [Document](#)'s [load timing info](#)'s [DOM content loaded event end time](#) to the [current high resolution time](#) given the [Document](#)'s [relevant global object](#).
  4. Enable the [client message queue](#) of the [ServiceWorkerContainer](#) object whose associated [service worker client](#) is the [Document](#) object's [relevant settings object](#).
  5. Invoke [WebDriver BiDi DOM content loaded](#) with the [Document](#)'s [browsing context](#), and a new [WebDriver BiDi navigation status](#) whose [id](#) is the [Document](#) object's [navigation id](#), [status](#) is "[pending](#)", and [url](#) is the [Document](#) object's [URL](#).
  7. [Spin the event loop](#) until the [set of scripts that will execute as soon as possible](#) and the [list of scripts that will execute in order as soon as possible](#) are empty.
  8. [Spin the event loop](#) until there is nothing that *delays the load event* in the [Document](#).
  9. [Queue a global task](#) on the [DOM manipulation task source](#) given the [Document](#)'s [relevant global object](#) to run the following steps:
    1. [Update the current document readiness](#) to "[complete](#)".
    2. If the [Document](#) object's [browsing context](#) is null, then abort these steps.
    3. Let [window](#) be the [Document](#)'s [relevant global object](#).
    4. Set the [Document](#)'s [load timing info](#)'s [load event start time](#) to the [current high resolution time](#) given [window](#).
    5. Fire an event named [load](#) at [window](#), with *legacy target override flag* set.
    6. Invoke [WebDriver BiDi load complete](#) with the [Document](#)'s [browsing context](#), and a new [WebDriver BiDi navigation status](#) whose [id](#) is the [Document](#) object's [navigation id](#), [status](#) is "[complete](#)", and [url](#) is the [Document](#) object's [URL](#).
    7. Set the [Document](#) object's [navigation id](#) to null.
    8. Set the [Document](#)'s [load timing info](#)'s [load event end time](#) to the [current high resolution time](#) given [window](#).
    9. Assert: [Document](#)'s [page showing](#) is false.

10. Set the [Document](#)'s [page showing](#) flag to true.
  11. [Fire a page transition event](#) named [pageshow](#) at [window](#) with false.
  12. [Completely finish loading](#) the [Document](#).
  13. [Queue the navigation timing entry](#) for the [Document](#).
10. If the [Document](#)'s [print when loaded](#) flag is set, then run the [printing steps](#).
  11. The [Document](#) is now *ready for post-load tasks*.

When the user agent is to *abort a parser*, it must run the following steps:

1. Throw away any pending content in the [input stream](#), and discard any future content that would have been added to it.
2. [Stop the speculative HTML parser](#) for this HTML parser.
3. [Update the current document readiness](#) to "[interactive](#)".
4. Pop *all* the nodes off the [stack of open elements](#).
5. [Update the current document readiness](#) to "[complete](#)".

### 13.2.8 Speculative HTML parsing

User agents may implement an optimization, as described in this section, to speculatively fetch resources that are declared in the HTML markup while the HTML parser is waiting for a [pending parsing-blocking script](#) to be fetched and executed, or during normal parsing, at the time [an element is created for a token](#). While this optimization is not defined in precise detail, there are some rules to consider for interoperability.

Each [HTML parser](#) can have an *active speculative HTML parser*. It is initially null.

The *speculative HTML parser* must act like the normal HTML parser (e.g., the tree builder rules apply), with some exceptions:

- The state of the normal HTML parser and the document itself must not be affected.  
For example, the [next input character](#) or the [stack of open elements](#) for the normal HTML parser is not affected by the [speculative HTML parser](#).
- Bytes pushed into the HTML parser's [input byte stream](#) must also be pushed into the speculative HTML parser's [input byte stream](#). Bytes read from the streams must be independent.
- The result of the speculative parsing is primarily a series of [speculative fetches](#). Which

kinds of resources to speculatively fetch is [implementation-defined](#), but user agents must not speculatively fetch resources that would not be fetched with the normal HTML parser, under the assumption that the script that is blocking the HTML parser does nothing.

It is possible that the same markup is seen multiple times from the [speculative HTML parser](#) and then the normal HTML parser. It is expected that duplicated fetches will be prevented by caching rules, which are not yet fully specified.

A *speculative fetch* for a [speculative mock element](#) *element* must follow these rules:

Should some of these things be applied to the document "for real", even though they are found speculatively?

- If the [speculative HTML parser](#) encounters one of the following elements, then act as if that element is processed for the purpose of its effect of subsequent speculative fetches.
  - A [base](#) element.
  - A [meta](#) element whose [http-equiv](#) attribute is in the [Content security policy](#) state.
  - A [meta](#) element whose [name](#) attribute is an [ASCII case-insensitive](#) match for "[referrer](#)".
  - A [meta](#) element whose [name](#) attribute is an [ASCII case-insensitive](#) match for "[viewport](#)". (This can affect whether a media query list [matches the environment](#).) [\[CSSDEVICEADAPT\]](#)
- Let *url* be the [URL](#) that *element* would fetch if it was processed normally. If there is no such [URL](#) or if it is the empty string, then do nothing. Otherwise, if *url* is already in the [list of speculative fetch URLs](#), then do nothing. Otherwise, fetch *url* as if the element was processed normally, and add *url* to the [list of speculative fetch URLs](#).

Each [Document](#) has a *list of speculative fetch URLs*, which is a [list](#) of [URLs](#), initially empty.

To start the *speculative HTML parser* for an instance of an HTML parser *parser*:

1. Optionally, return.

This step allows user agents to opt out of speculative HTML parsing.

2. If *parser*'s [active speculative HTML parser](#) is not null, then [stop the speculative HTML parser](#) for *parser*.

This can happen when [document.write\(\)](#) writes another parser-blocking script. For simplicity, this specification always restarts speculative parsing, but user agents can implement a more efficient strategy, so long as the end result is equivalent.

3. Let *speculativeParser* be a new [speculative HTML parser](#), with the same state as *parser*.

4. Let *speculativeDoc* be a new isomorphic representation of *parser*'s [Document](#), where all elements are instead [speculative mock elements](#). Let *speculativeParser* parse into *speculativeDoc*.
5. Set *parser*'s [active speculative HTML parser](#) to *speculativeParser*.
6. [In parallel](#), run *speculativeParser* until it is stopped or until it reaches the end of its [input stream](#).

To stop the speculative HTML parser for an instance of an HTML parser *parser*:

1. Let *speculativeParser* be *parser*'s [active speculative HTML parser](#).
2. If *speculativeParser* is null, then return.
3. Throw away any pending content in *speculativeParser*'s [input stream](#), and discard any future content that would have been added to it.
4. Set *parser*'s [active speculative HTML parser](#) to null.

The [speculative HTML parser](#) will create [speculative mock elements](#) instead of normal elements. DOM operations that the tree builder normally does on elements are expected to work appropriately on speculative mock elements.

A *speculative mock element* is a [struct](#) with the following [items](#):

- A [string](#) *namespace*, corresponding to an element's [namespace](#).
- A [string](#) *local name*, corresponding to an element's [local name](#).
- A [list](#) *attribute list*, corresponding to an element's [attribute list](#).
- A [list](#) *children*, corresponding to an element's [children](#).

To create a *speculative mock element* given a *namespace*, *tagName*, and *attributes*:

1. Let *element* be a new [speculative mock element](#).
2. Set *element*'s [namespace](#) to *namespace*.
3. Set *element*'s [local name](#) to *tagName*.
4. Set *element*'s [attribute list](#) to *attributes*.
5. Set *element*'s [children](#) to a new empty [list](#).
6. Optionally, perform a [speculative fetch](#) for *element*.

## 7. Return *element*.

When the tree builder says to insert an element into a [template](#) element's [template contents](#), if that is a [speculative mock element](#), instead do nothing. URLs found speculatively inside [template](#) elements might themselves be templates, and must not be speculatively fetched.

### 13.2.9 Coercing an HTML DOM into an infoset

When an application uses an [HTML parser](#) in conjunction with an XML pipeline, it is possible that the constructed DOM is not compatible with the XML tool chain in certain subtle ways. For example, an XML toolchain might not be able to represent attributes with the name `xmllns`, since they conflict with the Namespaces in XML syntax. There is also some data that the [HTML parser](#) generates that isn't included in the DOM itself. This section specifies some rules for handling these issues.

If the XML API being used doesn't support DOCTYPES, the tool may drop DOCTYPES altogether.

If the XML API doesn't support attributes in no namespace that are named "`xmllns`", attributes whose names start with "`xmllns:`", or attributes in the [XMLNS namespace](#), then the tool may drop such attributes.

The tool may annotate the output with any namespace declarations required for proper operation.

If the XML API being used restricts the allowable characters in the local names of elements and attributes, then the tool may map all element and attribute local names that the API wouldn't support to a set of names that are allowed, by replacing any character that isn't supported with the uppercase letter U and the six digits of the character's code point when expressed in hexadecimal, using digits 0-9 and capital letters A-F as the symbols, in increasing numeric order.

For example, the element name `foo<bar`, which can be output by the [HTML parser](#), though it is neither a legal HTML element name nor a well-formed XML element name, would be converted into `fooU00003Cbar`, which is a well-formed XML element name (though it's still not legal in HTML by any means).

As another example, consider the attribute `xlink:href`. Used on a MathML element, it becomes, after being [adjusted](#), an attribute with a prefix "`xlink`" and a local name "`href`". However, used on an HTML element, it becomes an attribute with no prefix and the local name "`xlink:href`", which is not a valid NCName, and thus might not be accepted by an XML API. It could thus get converted, becoming "`xlinkU00003Ahref`".

The resulting names from this conversion conveniently can't clash with any attribute generated by the [HTML parser](#), since those are all either lowercase or those listed in the [adjust foreign attributes](#) algorithm's table.

If the XML API restricts comments from having two consecutive U+002D HYPHEN-MINUS characters (--), the tool may insert a single U+0020 SPACE character between any such offending characters.

If the XML API restricts comments from ending in a U+002D HYPHEN-MINUS character (-), the tool may insert a single U+0020 SPACE character at the end of such comments.

If the XML API restricts allowed characters in character data, attribute values, or comments, the tool may replace any U+000C FORM FEED (FF) character with a U+0020 SPACE character, and any other literal non-XML character with a U+FFFD REPLACEMENT CHARACTER.

If the tool has no way to convey out-of-band information, then the tool may drop the following information:

- Whether the document is set to [no-quirks mode](#), [limited-quirks mode](#), or [quirks mode](#)
- The association between form controls and forms that aren't their nearest [form](#) element ancestor (use of the [form element pointer](#) in the parser)
- The [template contents](#) of any [template](#) elements.

The mutations allowed by this section apply after the [HTML parser](#)'s rules have been applied. For example, a <a:> start tag will be closed by a </a:> end tag, and never by a </aU00003AU00003A> end tag, even if the user agent is using the rules above to then generate an actual element in the DOM with the name aU00003AU00003A for that start tag.

### 13.2.10 An introduction to error handling and strange cases in the parser

*This section is non-normative.*

This section examines some erroneous markup and discusses how the [HTML parser](#) handles these cases.

#### 13.2.10.1 Misnested tags: <b><i></b></i>

*This section is non-normative.*

The most-often discussed example of erroneous markup is as follows:

```
<p>12<i>34</i>5</p>
```

The parsing of this markup is straightforward up to the "3". At this point, the DOM looks like this:

- [html](#)
  - [head](#)
  - [body](#)
    - [p](#)

- [#text](#): 1
- [b](#)
  - [#text](#): 2
  - [i](#)
    - [#text](#): 3

Here, the [stack of open elements](#) has five elements on it: [html](#), [body](#), [p](#), [b](#), and [i](#). The [list of active formatting elements](#) just has two: [b](#) and [i](#). The [insertion mode](#) is "[in body](#)".

Upon receiving the end tag token with the tag name "b", the "[adoption agency algorithm](#)" is invoked. This is a simple case, in that the *formatting element* is the [b](#) element, and there is no *furthest block*. Thus, the [stack of open elements](#) ends up with just three elements: [html](#), [body](#), and [p](#), while the [list of active formatting elements](#) has just one: [i](#). The DOM tree is unmodified at this point.

The next token is a character ("4"), triggers the [reconstruction of the active formatting elements](#), in this case just the [i](#) element. A new [i](#) element is thus created for the "4" [Text](#) node. After the end tag token for the "i" is also received, and the "5" [Text](#) node is inserted, the DOM looks as follows:

- [html](#)
  - [head](#)
  - [body](#)
    - [p](#)
      - [#text](#): 1
      - [b](#)
        - [#text](#): 2
        - [i](#)
          - [#text](#): 3
      - [i](#)
        - [#text](#): 4
      - [#text](#): 5

### 13.2.10.2 Misnested tags: <b><p>2</b></p>

*This section is non-normative.*

A case similar to the previous one is the following:

<b>1<p>2</b>3</p>

Up to the "2" the parsing here is straightforward:

- [html](#)
  - [head](#)
  - [body](#)

- **b**
  - [#text](#): 1
  - **p**
    - [#text](#): 2

The interesting part is when the end tag token with the tag name "b" is parsed.

Before that token is seen, the [stack of open elements](#) has four elements on it: [html](#), [body](#), [b](#), and [p](#). The [list of active formatting elements](#) just has the one: [b](#). The [insertion mode](#) is "[in body](#)".

Upon receiving the end tag token with the tag name "b", the "[adoption agency algorithm](#)" is invoked, as in the previous example. However, in this case, there *is* a *furthest block*, namely the [p](#) element. Thus, this time the adoption agency algorithm isn't skipped over.

The *common ancestor* is the [body](#) element. A conceptual "bookmark" marks the position of the [b](#) in the [list of active formatting elements](#), but since that list has only one element in it, the bookmark won't have much effect.

As the algorithm progresses, *node* ends up set to the formatting element ([b](#)), and *last node* ends up set to the *furthest block* ([p](#)).

The *last node* gets appended (moved) to the *common ancestor*, so that the DOM looks like:

- [html](#)
  - [head](#)
  - [body](#)
    - **b**
      - [#text](#): 1
    - **p**
      - [#text](#): 2

A new [b](#) element is created, and the children of the [p](#) element are moved to it:

- [html](#)
  - [head](#)
  - [body](#)
    - **b**
      - [#text](#): 1
    - **p**
  - **b**
    - [#text](#): 2

Finally, the new [b](#) element is appended to the [p](#) element, so that the DOM looks like:

- [html](#)
  - [head](#)
  - [body](#)
    - [b](#)
      - [#text](#): 1
    - [p](#)
      - [b](#)
        - [#text](#): 2

The [b](#) element is removed from the [list of active formatting elements](#) and the [stack of open elements](#), so that when the "3" is parsed, it is appended to the [p](#) element:

- [html](#)
  - [head](#)
  - [body](#)
    - [b](#)
      - [#text](#): 1
    - [p](#)
      - [b](#)
        - [#text](#): 2
      - [#text](#): 3

#### 13.2.10.3 Unexpected markup in tables

*This section is non-normative.*

Error handling in tables is, for historical reasons, especially strange. For example, consider the following markup:

```
<table><tr><td>aaa</td></tr>bbb</table>ccc
```

The highlighted [b](#) element start tag is not allowed directly inside a table like that, and the parser handles this case by placing the element *before* the table. (This is called [foster parenting](#).) This can be seen by examining the DOM tree as it stands just after the [table](#) element's start tag has been seen:

- [html](#)
  - [head](#)
  - [body](#)
    - [table](#)

...and then immediately after the [b](#) element start tag has been seen:

- [html](#)
  - [head](#)
  - [body](#)

- [b](#)
- [table](#)

At this point, the [stack of open elements](#) has on it the elements [html](#), [body](#), [table](#), and [b](#) (in that order, despite the resulting DOM tree); the [list of active formatting elements](#) just has the [b](#) element in it; and the [insertion mode](#) is "[in table](#)".

The [tr](#) start tag causes the [b](#) element to be popped off the stack and a [tbody](#) start tag to be implied; the [tbody](#) and [tr](#) elements are then handled in a rather straight-forward manner, taking the parser through the "[in table body](#)" and "[in row](#)" insertion modes, after which the DOM looks as follows:

- [html](#)
  - [head](#)
  - [body](#)
    - [b](#)
    - [table](#)
      - [tbody](#)
        - [tr](#)

Here, the [stack of open elements](#) has on it the elements [html](#), [body](#), [table](#), [tbody](#), and [tr](#); the [list of active formatting elements](#) still has the [b](#) element in it; and the [insertion mode](#) is "[in row](#)".

The [td](#) element start tag token, after putting a [td](#) element on the tree, puts a [marker](#) on the [list of active formatting elements](#) (it also switches to the "[in cell](#)" [insertion mode](#)).

- [html](#)
  - [head](#)
  - [body](#)
    - [b](#)
    - [table](#)
      - [tbody](#)
        - [tr](#)
          - [td](#)

The [marker](#) means that when the "aaa" character tokens are seen, no [b](#) element is created to hold the resulting [Text](#) node:

- [html](#)
  - [head](#)
  - [body](#)
    - [b](#)
    - [table](#)
      - [tbody](#)
        - [tr](#)

- [td](#)
  - [#text](#): aaa

The end tags are handled in a straight-forward manner; after handling them, the [stack of open elements](#) has on it the elements [html](#), [body](#), [table](#), and [tbody](#); the [list of active formatting elements](#) still has the [b](#) element in it (the [marker](#) having been removed by the "td" end tag token); and the [insertion mode](#) is "[in table body](#)".

Thus it is that the "bbb" character tokens are found. These trigger the "[in table text](#)" insertion mode to be used (with the [original insertion mode](#) set to "[in table body](#)"). The character tokens are collected, and when the next token (the [table](#) element end tag) is seen, they are processed as a group. Since they are not all spaces, they are handled as per the "anything else" rules in the "[in table](#)" insertion mode, which defer to the "[in body](#)" insertion mode but with [foster parenting](#).

When [the active formatting elements are reconstructed](#), a [b](#) element is created and [foster parented](#), and then the "bbb" [Text](#) node is appended to it:

- [html](#)
  - [head](#)
  - [body](#)
    - [b](#)
    - [b](#)
      - [#text](#): bbb
    - [table](#)
      - [tbody](#)
        - [tr](#)
          - [td](#)
            - [#text](#): aaa

The [stack of open elements](#) has on it the elements [html](#), [body](#), [table](#), [tbody](#), and the new [b](#) (again, note that this doesn't match the resulting tree!); the [list of active formatting elements](#) has the new [b](#) element in it; and the [insertion mode](#) is still "[in table body](#)".

Had the character tokens been only [ASCII whitespace](#) instead of "bbb", then that [ASCII whitespace](#) would just be appended to the [tbody](#) element.

Finally, the [table](#) is closed by a "table" end tag. This pops all the nodes from the [stack of open elements](#) up to and including the [table](#) element, but it doesn't affect the [list of active formatting elements](#), so the "ccc" character tokens after the table result in yet another [b](#) element being created, this time after the table:

- [html](#)
  - [head](#)
  - [body](#)
    - [b](#)
    - [b](#)

- `#text`: bbb
- `table`
- `tbody`
- `tr`
- `td`
- `#text`: aaa
- `b`
- `#text`: ccc

#### 13.2.10.4 Scripts that modify the page as it is being parsed

*This section is non-normative.*

Consider the following markup, which for this example we will assume is the document with URL `https://example.com/inner`, being rendered as the content of an `iframe` in another document with the URL `https://example.com/outer`:

```
<div id=a>
<script>
 var div = document.getElementById('a');
 parent.document.body.appendChild(div);
</script>
<script>
 alert(document.URL);
</script>
</div>
<script>
 alert(document.URL);
</script>
```

Up to the first "script" end tag, before the script is parsed, the result is relatively straightforward:

- `html`
  - `head`
  - `body`
    - `div id="a"`
      - `#text`:
      - `script`
        - `#text`: var div = document.getElementById('a'); ↵
 parent.document.body.appendChild(div);

After the script is parsed, though, the `div` element and its child `script` element are gone:

- `html`
  - `head`

- [body](#)

They are, at this point, in the [Document](#) of the aforementioned outer [browsing context](#). However, the [stack of open elements](#) *still contains the [div](#) element*.

Thus, when the second [script](#) element is parsed, it is inserted *into the outer [Document](#) object*.

Those parsed into different [Documents](#) than the one the parser was created for do not execute, so the first alert does not show.

Once the [div](#) element's end tag is parsed, the [div](#) element is popped off the stack, and so the next [script](#) element is in the inner [Document](#):

- [html](#)
  - [head](#)
  - [body](#)
    - [script](#)
      - [#text](#): alert(document.URL);

This script does execute, resulting in an alert that says "https://example.com/inner".

#### 13.2.10.5 The execution of scripts that are moving across multiple documents

*This section is non-normative.*

Elaborating on the example in the previous section, consider the case where the second [script](#) element is an external script (i.e. one with a [src](#) attribute). Since the element was not in the parser's [Document](#) when it was created, that external script is not even downloaded.

In a case where a [script](#) element with a [src](#) attribute is parsed normally into its parser's [Document](#), but while the external script is being downloaded, the element is moved to another document, the script continues to download, but does not execute.

In general, moving [script](#) elements between [Documents](#) is considered a bad practice.

#### 13.2.10.6 Unclosed formatting elements

*This section is non-normative.*

The following markup shows how nested formatting elements (such as [b](#)) get collected and continue to be applied even as the elements they are contained in are closed, but that excessive duplicates are thrown away.

```
<!DOCTYPE html>
<p><b class=x><b class=x><b class=x><b class=x>X
<p>X
<p><b class=x>X
```

<del><p></p></del>

The resulting DOM tree is as follows:

- DOCTYPE: html
  - html
    - head
    - body
      - p
        - b class="x"
          - b class="x"
            - b
              - b class="x"
              - b class="x"
                - b
          - #text: X ↴
        - p
          - b class="x"
            - b
              - b class="x"
                - b class="x"
                  - b
            - #text: X ↴
          - p
            - b class="x"
              - b
                - b class="x"
                  - b class="x"
                    - b
              - b class="x"
                - b
              - #text: X ↴
            - p
              - #text: X ↴

Note how the second **p** element in the markup has no explicit **b** elements, but in the resulting DOM, up to three of each kind of formatting element (in this case three **b** elements with the class attribute, and two unadorned **b** elements) get reconstructed before the element's "X".

Also note how this means that in the final paragraph only six **b** end tags are needed to completely clear the [list of active formatting elements](#), even though nine **b** start tags have been seen up to this point.

### 13.3 Serializing HTML fragments

For the purposes of the following algorithm, an element *serializes as void* if its element type is one of the [void elements](#), or is [basefont](#), [bgsound](#), [frame](#), or [keygen](#).

The following steps form the *HTML fragment serialization algorithm*. The algorithm takes as input a DOM [Element](#), [Document](#), or [DocumentFragment](#) referred to as *the node*, and returns a string.

This algorithm serializes the *children* of the node being serialized, not the node itself.

1. If *the node* [serializes as void](#), then return the empty string.
2. Let *s* be a string, and initialize it to the empty string.
3. If *the node* is a [template](#) element, then let *the node* instead be the [template](#) element's [template contents](#) (a [DocumentFragment](#) node).
4. For each child node of *the node*, in [tree order](#), run the following steps:
  1. Let *current node* be the child node being processed.
  2. Append the appropriate string from the following list to *s*:

#### If *current node* is an **Element**

If *current node* is an element in the [HTML namespace](#), the [MathML namespace](#), or the [SVG namespace](#), then let *tagname* be *current node*'s local name. Otherwise, let *tagname* be *current node*'s qualified name.

Append a U+003C LESS-THAN SIGN character (<), followed by *tagname*.

For [HTML elements](#) created by the [HTML parser](#) or [createElement\(\)](#), *tagname* will be lowercase.

If *current node*'s [is value](#) is not null, and the element does not have an [is](#) attribute in its attribute list, then append the string " [is=""](#)", followed by *current node*'s [is value escaped as described below](#) in *attribute mode*, followed by a U+0022 QUOTATION MARK character (").

For each attribute that the element has, append a U+0020 SPACE character, the [attribute's serialized name as described below](#), a U+003D EQUALS SIGN character (=), a U+0022 QUOTATION MARK character ("), the attribute's value, [escaped as described below](#) in *attribute mode*, and a second U+0022 QUOTATION MARK character (").

An *attribute's serialized name* for the purposes of the previous paragraph

must be determined as follows:

#### If the attribute has no namespace

The attribute's serialized name is the attribute's local name.

For attributes on [HTML elements](#) set by the [HTML parser](#) or by [setAttribute\(\)](#), the local name will be lowercase.

#### If the attribute is in the [XML namespace](#)

The attribute's serialized name is the string "`xml:`" followed by the attribute's local name.

#### If the attribute is in the [XMLNS namespace](#) and the attribute's local name is `xmlns`

The attribute's serialized name is the string "`xmlns`".

#### If the attribute is in the [XMLNS namespace](#) and the attribute's local name is not `xmlns`

The attribute's serialized name is the string "`xmlns:`" followed by the attribute's local name.

#### If the attribute is in the [XLink namespace](#)

The attribute's serialized name is the string "`xlink:`" followed by the attribute's local name.

#### If the attribute is in some other namespace

The attribute's serialized name is the attribute's qualified name.

While the exact order of attributes is [implementation-defined](#), and may depend on factors such as the order that the attributes were given in the original markup, the sort order must be stable, such that consecutive invocations of this algorithm serialize an element's attributes in the same order.

Append a U+003E GREATER-THAN SIGN character (>).

If *current node* [serializes as void](#), then [continue](#) on to the next child node at this point.

Append the value of running the [HTML fragment serialization algorithm](#) on the *current node* element (thus recursing into this algorithm for that element), followed by a U+003C LESS-THAN SIGN character (<), a U+002F

SOLIDUS character (/), *tagname* again, and finally a U+003E GREATER-THAN SIGN character (>).

If *current node* is a **Text** node

If the parent of *current node* is a [style](#), [script](#), [xmp](#), [iframe](#), [noembed](#), [noframes](#), or [plaintext](#) element, or if the parent of *current node* is a [noscript](#) element and [scripting is enabled](#) for the node, then append the value of *current node*'s **data** IDL attribute literally.

Otherwise, append the value of *current node*'s **data** IDL attribute, [escaped as described below](#).

If *current node* is a **Comment**

Append the literal string "<! --" (U+003C LESS-THAN SIGN, U+0021 EXCLAMATION MARK, U+002D HYPHEN-MINUS, U+002D HYPHEN-MINUS), followed by the value of *current node*'s **data** IDL attribute, followed by the literal string "-->" (U+002D HYPHEN-MINUS, U+002D HYPHEN-MINUS, U+003E GREATER-THAN SIGN).

If *current node* is a **ProcessingInstruction**

Append the literal string "<?" (U+003C LESS-THAN SIGN, U+003F QUESTION MARK), followed by the value of *current node*'s **target** IDL attribute, followed by a single U+0020 SPACE character, followed by the value of *current node*'s **data** IDL attribute, followed by a single U+003E GREATER-THAN SIGN character (>).

If *current node* is a **DocumentType**

Append the literal string "<!DOCTYPE" (U+003C LESS-THAN SIGN, U+0021 EXCLAMATION MARK, U+0044 LATIN CAPITAL LETTER D, U+004F LATIN CAPITAL LETTER O, U+0043 LATIN CAPITAL LETTER C, U+0054 LATIN CAPITAL LETTER T, U+0059 LATIN CAPITAL LETTER Y, U+0050 LATIN CAPITAL LETTER P, U+0045 LATIN CAPITAL LETTER E), followed by a space (U+0020 SPACE), followed by the value of *current node*'s **name** IDL attribute, followed by the literal string ">" (U+003E GREATER-THAN SIGN).

5. Return *s*.

It is possible that the output of this algorithm, if parsed with an [HTML parser](#), will not return the original tree structure. Tree structures that do not roundtrip a serialize and reparse step can also be produced by the [HTML parser](#) itself, although such cases are typically non-conforming.

For instance, if a [textarea](#) element to which a **Comment** node has been appended is serialized

and the output is then reparsed, the comment will end up being displayed in the text control. Similarly, if, as a result of DOM manipulation, an element contains a comment that contains the literal string "`-->`", then when the result of serializing the element is parsed, the comment will be truncated at that point and the rest of the comment will be interpreted as markup. More examples would be making a `script` element contain a `Text` node with the text string "`</script>`", or having a `p` element that contains a `ul` element (as the `ul` element's `start tag` would imply the end tag for the `p`).

This can enable cross-site scripting attacks. An example of this would be a page that lets the user enter some font family names that are then inserted into a CSS `style` block via the DOM and which then uses the `innerHTML` IDL attribute to get the HTML serialization of that `style` element: if the user enters "`</style><script>attack</script>`" as a font family name, `innerHTML` will return markup that, if parsed in a different context, would contain a `script` node, even though no `script` node existed in the original DOM.

For example, consider the following markup:

```
<form id="outer"><div></form><form id="inner"><input>
```

This will be parsed into:

- `html`
  - `head`
  - `body`
    - `form id="outer"`
      - `div`
        - `form id="inner"`
          - `input`

The `input` element will be associated with the inner `form` element. Now, if this tree structure is serialized and reparsed, the `<form id="inner">` start tag will be ignored, and so the `input` element will be associated with the outer `form` element instead.

```
<html><head></head><body><form id="outer"><div><form id="inner"><input></form>
```

- `html`
  - `head`
  - `body`
    - `form id="outer"`
      - `div`
        - `input`

As another example, consider the following markup:

```
<a><table><a>
```

This will be parsed into:

- [html](#)
  - [head](#)
  - [body](#)
    - [a](#)
      - [a](#)
      - [table](#)

That is, the [a](#) elements are nested, because the second [a](#) element is [foster parented](#). After a serialize-reparse roundtrip, the [a](#) elements and the [table](#) element would all be siblings, because the second `<a>` start tag implicitly closes the first [a](#) element.

```
<html><head></head><body><a><a><table></table></body></html>
```

- [html](#)
  - [head](#)
  - [body](#)
    - [a](#)
    - [a](#)
    - [table](#)

For historical reasons, this algorithm does not round-trip an initial U+000A LINE FEED (LF) character in [pre](#), [textarea](#), or [listing](#) elements, even though (in the first two cases) the markup being round-tripped can be conforming. The [HTML parser](#) will drop such a character during parsing, but this algorithm does *not* serialize an extra U+000A LINE FEED (LF) character.

For example, consider the following markup:

```
<pre>
Hello.</pre>
```

When this document is first parsed, the [pre](#) element's [child text content](#) starts with a single newline character. After a serialize-reparse roundtrip, the [pre](#) element's [child text content](#) is simply "Hello.".

Because of the special role of the [is](#) attribute in signaling the creation of [customized built-in elements](#), in that it provides a mechanism for parsed HTML to set the element's [is value](#), we special-case its handling during serialization. This ensures that an element's [is value](#) is preserved through serialize-parse roundtrips.

When creating a [customized built-in element](#) via the parser, a developer uses the [is](#) attribute directly; in such cases serialize-parse roundtrips work fine.

```
<script>
window.SuperP = class extends HTMLElement {};
customElements.define("super-p", SuperP, { extends: "p" });
```

```
</script>

<div id="container"><p is="super-p">Superb!</p></div>

<script>
console.log(container.innerHTML); // <p is="super-p">
container.innerHTML = container.innerHTML;
console.log(container.innerHTML); // <p is="super-p">
console.assert(container.firstChild instanceof SuperP);
</script>
```

But when creating a customized built-in element via its [constructor](#) or via [createElement\(\)](#), the [is](#) attribute is not added. Instead, the [is value](#) (which is what the custom elements machinery uses) is set without intermediating through an attribute.

```
<script>
container.innerHTML = "";
const p = document.createElement("p", { is: "super-p" });
container.appendChild(p);

// The is attribute is not present in the DOM:
console.assert(!p.hasAttribute("is"));

// But the element is still a super-p:
console.assert(p instanceof SuperP);
</script>
```

To ensure that serialize-parse roundtrips still work, the serialization process explicitly writes out the element's [is value](#) as an [is](#) attribute:

```
<script>
console.log(container.innerHTML); // <p is="super-p">
container.innerHTML = container.innerHTML;
console.log(container.innerHTML); // <p is="super-p">
console.assert(container.firstChild instanceof SuperP);
</script>
```

*Escaping a string* (for the purposes of the algorithm above) consists of running the following steps:

1. Replace any occurrence of the "&" character by the string "&".
2. Replace any occurrences of the U+00A0 NO-BREAK SPACE character by the string " ".
3. If the algorithm was invoked in the *attribute mode*, replace any occurrences of the "" character by the string """.

4. If the algorithm was *not* invoked in the *attribute mode*, replace any occurrences of the "<" character by the string "&lt;", and any occurrences of the ">" character by the string "&gt;".

## 13.4 Parsing HTML fragments

The following steps form the *HTML fragment parsing algorithm*. The algorithm takes as input an [Element](#) node, referred to as the *context element*, which gives the context for the parser, as well as *input*, a string to parse, and returns a list of zero or more nodes.

Parts marked *fragment case* in algorithms in the parser section are parts that only occur if the parser was created for the purposes of this algorithm. The algorithms have been annotated with such markings for informational purposes only; such markings have no normative weight. If it is possible for a condition described as a [fragment case](#) to occur even when the parser wasn't created for the purposes of handling this algorithm, then that is an error in the specification.

1. Create a new [Document](#) node, and mark it as being an [HTML document](#).
2. If the [node document](#) of the [context](#) element is in [quirks mode](#), then let the [Document](#) be in [quirks mode](#). Otherwise, the [node document](#) of the [context](#) element is in [limited-quirks mode](#), then let the [Document](#) be in [limited-quirks mode](#). Otherwise, leave the [Document](#) in [no-quirks mode](#).
3. Create a new [HTML parser](#), and associate it with the just created [Document](#) node.
4. Set the state of the [HTML parser](#)'s [tokenization](#) stage as follows, switching on the [context](#) element:
  - [title](#)**  
Switch the tokenizer to the [RCDATA state](#).
  - [textarea](#)**  
Switch the tokenizer to the [RCDATA state](#).
  - [style](#)**  
**[xmp](#)**  
**[iframe](#)**  
**[noembed](#)**  
**[noframes](#)**  
Switch the tokenizer to the [RAWTEXT state](#).
  - [script](#)**  
Switch the tokenizer to the [script data state](#).
  - [noscript](#)**  
If the [scripting flag](#) is enabled, switch the tokenizer to the [RAWTEXT state](#). Otherwise, leave the tokenizer in the [data state](#).

**[script](#)**  
Switch the tokenizer to the [script data state](#).

**[noscript](#)**  
If the [scripting flag](#) is enabled, switch the tokenizer to the [RAWTEXT state](#). Otherwise, leave the tokenizer in the [data state](#).

## [plaintext](#)

Switch the tokenizer to the [PLAINTEXT state](#).

## Any other element

Leave the tokenizer in the [data state](#).

For performance reasons, an implementation that does not report errors and that uses the actual state machine described in this specification directly could use the PLAINTEXT state instead of the RAWTEXT and script data states where those are mentioned in the list above. Except for rules regarding parse errors, they are equivalent, since there is no [appropriate end tag token](#) in the fragment case, yet they involve far fewer state transitions.

5. Let *root* be a new [html](#) element with no attributes.
6. Append the element *root* to the [Document](#) node created above.
7. Set up the parser's [stack of open elements](#) so that it contains just the single element *root*.
8. If the [context](#) element is a [template](#) element, push "[in template](#)" onto the [stack of template insertion modes](#) so that it is the new [current template insertion mode](#).
9. Create a start tag token whose name is the local name of [context](#) and whose attributes are the attributes of [context](#).

Let this start tag token be the start tag token of the [context](#) node, e.g. for the purposes of determining if it is an [HTML integration point](#).

10. [Reset the parser's insertion mode appropriately](#).

The parser will reference the [context](#) element as part of that algorithm.

11. Set the parser's [form element pointer](#) to the nearest node to the [context](#) element that is a [form](#) element (going straight up the ancestor chain, and including the element itself, if it is a [form](#) element), if any. (If there is no such [form](#) element, the [form element pointer](#) keeps its initial value, null.)
12. Place the *input* into the [input stream](#) for the [HTML parser](#) just created. The encoding [confidence](#) is *irrelevant*.
13. Start the parser and let it run until it has consumed all the characters just inserted into the input stream.
14. Return the child nodes of *root*, in [tree order](#).

## 13.5 Named character references

This table lists the character reference names that are supported by HTML, and the code points

to which they refer. It is referenced by the previous sections.

It is intentional, for legacy compatibility, that many code points have multiple character reference names. For example, some appear both with and without the trailing semicolon, or with different capitalizations.

| Name      | Character(s)    | Glyph | Name           | Character(s) | Glyph |
|-----------|-----------------|-------|----------------|--------------|-------|
| Aacute;   | U+000C1         | Á     | angmsdag;      | U+029AE      | ꝧ     |
| Aacute    | U+000C1         | Á     | angmsdah;      | U+029AF      | Ꝩ     |
| aacute;   | U+000E1         | á     | angrt;         | U+0221F      | ꝩ     |
| aacute    | U+000E1         | á     | angrtvb;       | U+022BE      | Ꝫ     |
| Abreve;   | U+00102         | Ă     | angrtvbd;      | U+0299D      | ꝫ     |
| abreve;   | U+00103         | ă     | angsph;        | U+02222      | Ꝯ     |
| ac;       | U+0223E         | ~     | angst;         | U+000C5      | Â     |
| acd;      | U+0223F         | ~     | angzarr;       | U+0237C      | ꝯ     |
| acE;      | U+0223E U+00333 | ꝩ     | Aogon;         | U+00104      | À     |
| Acirc;    | U+000C2         | Â     | aogon;         | U+00105      | ܂     |
| Acirc     | U+000C2         | Â     | Aopf;          | U+1D538      | ܂     |
| acirc;    | U+000E2         | â     | aopf;          | U+1D552      | ܂     |
| acirc     | U+000E2         | â     | ap;            | U+02248      | ܂     |
| acute;    | U+000B4         | '     | apacir;        | U+02A6F      | ܂     |
| acute     | U+000B4         | '     | apE;           | U+02A70      | ܂     |
| Acy;      | U+00410         | ା     | ape;           | U+0224A      | ܂     |
| acy;      | U+00430         | ା     | apid;          | U+0224B      | ܂     |
| AElig;    | U+000C6         | ଏ     | apos;          | U+00027      | '     |
| AElig     | U+000C6         | ଏ     | ApplyFunction; | U+02061      |       |
| aelig;    | U+000E6         | ୧ୟ    | approx;        | U+02248      | ܂     |
| aelig     | U+000E6         | ୧ୟ    | approxeq;      | U+0224A      | ܂     |
| af;       | U+02061         |       | Aring;         | U+000C5      | Â     |
| Afr;      | U+1D504         | ଙ୍କ   | Aring          | U+000C5      | Â     |
| afr;      | U+1D51E         | ଙ୍କ   | aring;         | U+000E5      | ା     |
| Agrave;   | U+000C0         | ଙ୍ଗ   | aring          | U+000E5      | ା     |
| Agrave    | U+000C0         | ଙ୍ଗ   | Ascr;          | U+1D49C      | ܂     |
| agrave;   | U+000E0         | ଙ୍ଗ   | ascr;          | U+1D4B6      | ା     |
| agrave    | U+000E0         | ଙ୍ଗ   | Assign;        | U+02254      | :=    |
| alefsym;  | U+02135         | ଙ୍କ   | ast;           | U+0002A      | *     |
| aleph;    | U+02135         | ଙ୍କ   | asymp;         | U+02248      | ܂     |
| Alpha;    | U+00391         | ା     | asymeq;        | U+0224D      | ܂     |
| alpha;    | U+003B1         | ା     | Atilde;        | U+000C3      | Â     |
| Amacr;    | U+00100         | ଙ୍ଗ   | Atilde         | U+000C3      | Â     |
| amacr;    | U+00101         | ଙ୍ଗ   | atilde;        | U+000E3      | ା     |
| amalg;    | U+02A3F         | ଙ୍କ   | atilde         | U+000E3      | ା     |
| AMP;      | U+00026         | &     | Auml;          | U+000C4      | Ã     |
| AMP       | U+00026         | &     | Auml           | U+000C4      | Ã     |
| amp;      | U+00026         | &     | auml;          | U+000E4      | ା     |
| amp       | U+00026         | &     | auml           | U+000E4      | ା     |
| And;      | U+02A53         | ଙ୍କ   | awconint;      | U+02233      | ି     |
| and;      | U+02227         | ଙ୍କ   | awint;         | U+02A11      | ି     |
| andand;   | U+02A55         | ଙ୍କ   | backcong;      | U+0224C      | ܂     |
| andd;     | U+02A5C         | ଙ୍କ   | backepsilon;   | U+003F6      | ୧୦    |
| andslope; | U+02A58         | ଙ୍କ   | backprime;     | U+02035      | ୱ     |
| andv;     | U+02A5A         | ଙ୍କ   | backsim;       | U+0223D      | ୱ     |
| ang;      | U+02220         | ଙ୍କ   | backsimeq;     | U+022CD      | ୱ     |
| ange;     | U+029A4         | ଙ୍କ   | Backslash;     | U+02216      | ଳ     |
| angle;    | U+02220         | ଙ୍କ   | Barv;          | U+02AE7      | ର୍ତ   |
| angmsd;   | U+02221         | ଙ୍କ   | barvee;        | U+022BD      | ର୍ବ   |
| angmsdaa; | U+029A8         | ଙ୍କ   | Barwed;        | U+02306      | ର୍ବ   |
| angmsdab; | U+029A9         | ଙ୍କ   | barwed;        | U+02305      | ର୍ବ   |
| angmsdac; | U+029AA         | ଙ୍କ   | barwedge;      | U+02305      | ର୍ବ   |
| angmsdad; | U+029AB         | ଙ୍କ   | bbrk;          | U+023B5      | ଳ     |
| angmsdae; | U+029AC         | ଙ୍କ   | bbrktbrk;      | U+023B6      | ଳ     |
| angmsdaf; | U+029AD         | ଙ୍କ   | bcong;         | U+0224C      | ܂     |

| Name                | Character(s)    | Glyph | Name                  | Character(s)    | Glyph |
|---------------------|-----------------|-------|-----------------------|-----------------|-------|
| Bcy;                | U+00411         | ҂     | boxhD;                | U+02565         | Ҭ     |
| bcy;                | U+00431         | ҃     | boxhd;                | U+0252C         | Ҭ     |
| bdquo;              | U+0201E         | „     | boxHU;                | U+02569         | Ҭ     |
| becaus;             | U+02235         | ߲     | boxHu;                | U+02567         | ҭ     |
| Because;            | U+02235         | ߲     | boxhU;                | U+02568         | ҭ     |
| because;            | U+02235         | ߲     | boxhu;                | U+02534         | ҭ     |
| bemptyv;            | U+029B0         | ܂     | boxminus;             | U+0229F         | ܂     |
| bepsi;              | U+003F6         | ܃     | boxplus;              | U+0229E         | ܂     |
| bernou;             | U+0212C         | ܂     | boxtimes;             | U+022A0         | ܂     |
| Bernoullis;         | U+0212C         | ܂     | boxUL;                | U+0255D         | ܂     |
| Beta;               | U+00392         | ܂     | boxUl;                | U+0255C         | ܂     |
| beta;               | U+003B2         | ܂     | boxuL;                | U+0255B         | ܂     |
| beth;               | U+02136         | ܂     | boxul;                | U+02518         | ܂     |
| between;            | U+0226C         | ܂     | boxUR;                | U+0255A         | ܂     |
| Bfr;                | U+1D505         | ܂     | boxUr;                | U+02559         | ܂     |
| bfr;                | U+1D51F         | ܂     | boxuR;                | U+02558         | ܂     |
| bigcap;             | U+022C2         | ܂     | boxur;                | U+02514         | ܂     |
| bigcirc;            | U+025EF         | ܂     | boxV;                 | U+02551         | ܂     |
| bigcup;             | U+022C3         | ܂     | boxv;                 | U+02502         | ܂     |
| bigodot;            | U+02A00         | ܂     | boxVH;                | U+0256C         | ܂     |
| bigoplus;           | U+02A01         | ܂     | boxVh;                | U+0256B         | ܂     |
| bigotimes;          | U+02A02         | ܂     | boxvH;                | U+0256A         | ܂     |
| bigsqcup;           | U+02A06         | ܂     | boxvh;                | U+0253C         | ܂     |
| bigstar;            | U+02605         | ܂     | boxVL;                | U+02563         | ܂     |
| bigtriangledown;    | U+025BD         | ܂     | boxVl;                | U+02562         | ܂     |
| bigtriangleup;      | U+025B3         | ܂     | boxvL;                | U+02561         | ܂     |
| biguplus;           | U+02A04         | ܂     | boxvl;                | U+02524         | ܂     |
| bigvee;             | U+022C1         | ܂     | boxVR;                | U+02560         | ܂     |
| bigwedge;           | U+022C0         | ܂     | boxVr;                | U+0255F         | ܂     |
| bkarow;             | U+0290D         | ܂     | boxvR;                | U+0255E         | ܂     |
| blacklozenge;       | U+029EB         | ܂     | boxvr;                | U+0251C         | ܂     |
| blacksquare;        | U+025AA         | ܂     | bprime;               | U+02035         | ܂     |
| blacktriangle;      | U+025B4         | ܂     | Breve;                | U+002D8         | ܂     |
| blacktriangledown;  | U+025BE         | ܂     | breve;                | U+002D8         | ܂     |
| blacktriangleleft;  | U+025C2         | ܂     | brvbar;               | U+000A6         | ܂     |
| blacktriangleright; | U+025B8         | ܂     | brvbar                | U+000A6         | ܂     |
| blank;              | U+02423         | ܂     | Bscr;                 | U+0212C         | ܂     |
| blk12;              | U+02592         | ܂     | bscr;                 | U+1D4B7         | ܂     |
| blk14;              | U+02591         | ܂     | bsemi;                | U+0204F         | ܂     |
| blk34;              | U+02593         | ܂     | bsim;                 | U+0223D         | ܂     |
| block;              | U+02588         | ܂     | bsime;                | U+022CD         | ܂     |
| bne;                | U+0003D U+020E5 | ܂     | bsol;                 | U+0005C         | ܂     |
| bnequiv;            | U+02261 U+020E5 | ܂     | bsolb;                | U+029C5         | ܂     |
| bNot;               | U+02AED         | ܂     | bsolbsub;             | U+027C8         | ܂     |
| bnot;               | U+02310         | ܂     | bull;                 | U+02022         | ܂     |
| Bopf;               | U+1D539         | ܂     | bullet;               | U+02022         | ܂     |
| bopf;               | U+1D553         | ܂     | bump;                 | U+0224E         | ܂     |
| bot;                | U+022A5         | ܂     | bumpE;                | U+02AAE         | ܂     |
| bottom;             | U+022A5         | ܂     | bumpe;                | U+0224F         | ܂     |
| bowtie;             | U+022C8         | ܂     | Bumpeq;               | U+0224E         | ܂     |
| boxbox;             | U+029C9         | ܂     | bumpeq;               | U+0224F         | ܂     |
| boxDL;              | U+02557         | ܂     | Cacute;               | U+00106         | ܂     |
| boxDl;              | U+02556         | ܂     | cacute;               | U+00107         | ܂     |
| boxdL;              | U+02555         | ܂     | Cap;                  | U+022D2         | ܂     |
| boxdl;              | U+02510         | ܂     | cap;                  | U+02229         | ܂     |
| boxDR;              | U+02554         | ܂     | capand;               | U+02A44         | ܂     |
| boxDr;              | U+02553         | ܂     | capbrcup;             | U+02A49         | ܂     |
| boxdR;              | U+02552         | ܂     | capcap;               | U+02A4B         | ܂     |
| boxdr;              | U+0250C         | ܂     | capcup;               | U+02A47         | ܂     |
| boxH;               | U+02550         | ܂     | capdot;               | U+02A40         | ܂     |
| boxh;               | U+02500         | ܂     | CapitalDifferentialD; | U+02145         | ܂     |
| boxHD;              | U+02566         | ܂     | caps;                 | U+02229 U+0FE00 | ܂     |
| boxHd;              | U+02564         | ܂     | caret;                | U+02041         | ܂     |

| Name                      | Character(s) | Glyph | Name                             | Character(s)    | Glyph |
|---------------------------|--------------|-------|----------------------------------|-----------------|-------|
| caron;                    | U+002C7      | ˇ     | comp;                            | U+02201         | ⌚     |
| Cayleys;                  | U+0212D      | ⌚     | compfn;                          | U+02218         | ◦     |
| ccaps;                    | U+02A4D      | □     | complement;                      | U+02201         | ⌚     |
| Ccaron;                   | U+0010C      | Č     | complexes;                       | U+02102         | ⌚     |
| ccaron;                   | U+0010D      | č     | cong;                            | U+02245         | ≈     |
| Ccedil;                   | U+000C7      | Ҫ     | congdot;                         | U+02A6D         | ≈     |
| Ccedil                    | U+000C7      | Ҫ     | Congruent;                       | U+02261         | ≡     |
| ccedil;                   | U+000E7      | ҫ     | Conint;                          | U+0222F         | ƒ     |
| ccedil                    | U+000E7      | ҫ     | conint;                          | U+0222E         | ƒ     |
| Ccirc;                    | U+00108      | Ĉ     | ContourIntegral;                 | U+0222E         | ƒ     |
| ccirc;                    | U+00109      | ĉ     | Copf;                            | U+02102         | ⌚     |
| Cconint;                  | U+02230      | ff    | copf;                            | U+1D554         | ⌚     |
| ccups;                    | U+02A4C      | □     | coprod;                          | U+02210         | II    |
| ccupssm;                  | U+02A50      | ☒     | Coproduct;                       | U+02210         | II    |
| Cdot;                     | U+0010A      | Ć     | COPY;                            | U+000A9         | ⌚     |
| cdot;                     | U+0010B      | ć     | COPY                             | U+000A9         | ⌚     |
| cedil;                    | U+000B8      | ›     | copy;                            | U+000A9         | ⌚     |
| cedil                     | U+000B8      | ›     | copy                             | U+000A9         | ⌚     |
| Cedilla;                  | U+000B8      | ›     | copysr;                          | U+02117         | Ⓟ     |
| cemptyv;                  | U+029B2      | ∅     | CounterClockwiseContourIntegral; | U+02233         | ƒ     |
| cent;                     | U+000A2      | ¢     | crarr;                           | U+021B5         | ↶     |
| cent                      | U+000A2      | ¢     | Cross;                           | U+02A2F         | ×     |
| CenterDot;                | U+000B7      | ·     | cross;                           | U+02717         | ✗     |
| centerdot;                | U+000B7      | ·     | Cscr;                            | U+1D49E         | ⌚     |
| Cfr;                      | U+0212D      | ⌚     | cscr;                            | U+1D4B8         | ⌚     |
| cfr;                      | U+1D520      | ⌚     | csub;                            | U+02ACF         | □     |
| CHcy;                     | U+00427      | Ч     | csube;                           | U+02AD1         | □     |
| chcy;                     | U+00447      | ч     | csup;                            | U+02AD0         | □     |
| check;                    | U+02713      | ✓     | csupe;                           | U+02AD2         | □     |
| checkmark;                | U+02713      | ✓     | ctdot;                           | U+022EF         | …     |
| Chi;                      | U+003A7      | Х     | cudarrl;                         | U+02938         | ⤵     |
| chi;                      | U+003C7      | χ     | cudarr;                          | U+02935         | ⤶     |
| cir;                      | U+025CB      | ○     | cuepr;                           | U+022DE         | ⤷     |
| circ;                     | U+002C6      | ^     | cuesc;                           | U+022DF         | ⤷     |
| circeq;                   | U+02257      | ≈     | cularr;                          | U+021B6         | ⤵     |
| circlearrowleft;          | U+021BA      | ↺     | cularrp;                         | U+0293D         | ⤶     |
| circlearrowright;         | U+021BB      | ↻     | Cup;                             | U+022D3         | ⤸     |
| circledast;               | U+0229B      | ⊗     | cup;                             | U+0222A         | ⤹     |
| circledcirc;              | U+0229A      | ◎     | cupbrcap;                        | U+02A48         | ⤻     |
| circleddash;              | U+0229D      | ⊖     | CupCap;                          | U+0224D         | ⤷     |
| CircleDot;                | U+02299      | ◎     | cupcap;                          | U+02A46         | ⤻     |
| circledR;                 | U+000AE      | ®     | cupcup;                          | U+02A4A         | ⤻     |
| circledS;                 | U+024C8      | ⌚     | cupdot;                          | U+0228D         | ⤸     |
| CircleMinus;              | U+02296      | ⊖     | cupor;                           | U+02A45         | ⤸     |
| CirclePlus;               | U+02295      | ⊕     | cups;                            | U+0222A U+0FE00 | ⤹     |
| CircleTimes;              | U+02297      | ⊗     | curarr;                          | U+021B7         | ⤵     |
| cirE;                     | U+029C3      | ⌚     | curarrm;                         | U+0293C         | ⤶     |
| cire;                     | U+02257      | ≈     | curlyeqprec;                     | U+022DE         | ⤷     |
| cirfnint;                 | U+02A10      | ƒ     | curlyeqsucc;                     | U+022DF         | ⤷     |
| cirmid;                   | U+02AEF      | ؒ     | curlyvee;                        | U+022CE         | ȝ     |
| circscir;                 | U+029C2      | ଓ     | curlywedge;                      | U+022CF         | 人     |
| ClockwiseContourIntegral; | U+02232      | ƒ     | curren;                          | U+000A4         | ▫     |
| CloseCurlyDoubleQuote;    | U+0201D      | "     | curren                           | U+000A4         | ▫     |
| CloseCurlyQuote;          | U+02019      | ,     | curvearrowleft;                  | U+021B6         | ⤵     |
| clubs;                    | U+02663      | ♣     | curvearrowright;                 | U+021B7         | ⤶     |
| clubsuit;                 | U+02663      | ♣     | cuvee;                           | U+022CE         | ȝ     |
| Colon;                    | U+02237      | ::    | cuwed;                           | U+022CF         | 人     |
| colon;                    | U+0003A      | :     | cwconint;                        | U+02232         | ƒ     |
| Colone;                   | U+02A74      | ::=   | cwint;                           | U+02231         | ƒ     |
| colone;                   | U+02254      | ::=   | cylcty;                          | U+0232D         | ⤷     |
| coloned;                  | U+02254      | ::=   | Dagger;                          | U+02021         | ‡     |
| comma;                    | U+0002C      | ,     | dagger;                          | U+02020         | †     |
| commat;                   | U+00040      | @     | daleth;                          | U+02138         | ߱     |





| Name              | Character(s)    | Glyph | Name               | Character(s)    | Glyph    |
|-------------------|-----------------|-------|--------------------|-----------------|----------|
| frac38;           | U+0215C         | ¾     | GreaterGreater;    | U+02AA2         | »        |
| frac45;           | U+02158         | ¾     | GreaterLess;       | U+02277         | «        |
| frac56;           | U+0215A         | ½     | GreaterSlantEqual; | U+02A7E         | ≥        |
| frac58;           | U+0215D         | ½     | GreaterTilde;      | U+02273         | ≤        |
| frac78;           | U+0215E         | ¾     | Gscr;              | U+1D4A2         | ڻ        |
| frasl;            | U+02044         | /     | gscr;              | U+0210A         | ڻ        |
| frown;            | U+02322         | ˜     | gsim;              | U+02273         | ≥        |
| Fscr;             | U+02131         | ڦ     | gsime;             | U+02A8E         | ≤        |
| fscr;             | U+1D4BB         | ڦ     | gsiml;             | U+02A90         | ≈        |
| gacute;           | U+001F5         | ǵ     | GT;                | U+0003E         | >        |
| Gamma;            | U+00393         | Γ     | GT                 | U+0003E         | >        |
| gamma;            | U+003B3         | γ     | Gt;                | U+0226B         | »»       |
| Gammad;           | U+003DC         | Ϝ     | gt;                | U+0003E         | >        |
| gammad;           | U+003DD         | ϝ     | gt                 | U+0003E         | >        |
| gap;              | U+02A86         | ≥≈    | gtcc;              | U+02AA7         | ▷        |
| Gbreve;           | U+0011E         | Ӯ     | gtcir;             | U+02A7A         | »        |
| gbreve;           | U+0011F         | ӯ     | gtdot;             | U+022D7         | >        |
| Gcedil;           | U+00122         | Ӯ     | gtlPar;            | U+02995         | ﴿        |
| Gcirc;            | U+0011C         | Ӯ     | gtquest;           | U+02A7C         | ˃        |
| gcirc;            | U+0011D         | Ӯ     | gtrapprox;         | U+02A86         | ≈≈≈≈     |
| Gcy;              | U+00413         | Ӯ     | gtrarr;            | U+02978         | ↓↓       |
| gcy;              | U+00433         | Ր     | gtrdot;            | U+022D7         | >        |
| Gdot;             | U+00120         | Ӯ     | gtreqless;         | U+022DB         | ≈≈≈≈≈≈≈≈ |
| gdot;             | U+00121         | Ӯ     | gtreqqless;        | U+02A8C         | ≈≈≈≈≈≈≈≈ |
| gE;               | U+02267         | ≥≈    | gtrless;           | U+02277         | ≈≈≈≈≈≈≈≈ |
| ge;               | U+02265         | ≥≈    | gtrsim;            | U+02273         | ≈≈≈≈≈≈≈≈ |
| gEl;              | U+02A8C         | ≈≈≈≈  | gvertneqq;         | U+02269 U+0FE00 | ≈≈≈≈     |
| gel;              | U+022DB         | ≈≈≈≈  | gvnE;              | U+02269 U+0FE00 | ≈≈≈≈     |
| geq;              | U+02265         | ≥≈    | Hacek;             | U+002C7         | ˇ        |
| geqq;             | U+02267         | ≥≈    | hairsp;            | U+0200A         |          |
| geqlslant;        | U+02A7E         | ≥≈    | half;              | U+000BD         | ½        |
| ges;              | U+02A7E         | ≥≈    | hamilt;            | U+0210B         | ڢ        |
| gescc;            | U+02AA9         | ▷     | HARDcy;            | U+0042A         | ڏ        |
| gesdot;           | U+02A80         | ≥≈    | hardcy;            | U+0044A         | ڏ        |
| gesdoto;          | U+02A82         | ≥≈    | hArr;              | U+021D4         | ↔        |
| gesdotol;         | U+02A84         | ≥≈    | harr;              | U+02194         | ↔        |
| gesl;             | U+022DB U+0FE00 | ≈≈≈≈  | harrcir;           | U+02948         | ↔        |
| gesles;           | U+02A94         | ≈≈≈≈  | harrw;             | U+021AD         | ↔        |
| Gfr;              | U+1D50A         | Ӯ     | Hat;               | U+0005E         | ^\n      |
| gfr;              | U+1D524         | Ӯ     | hbar;              | U+0210F         | ڻ        |
| Gg;               | U+022D9         | »»    | Hcirc;             | U+00124         | ߵ        |
| gg;               | U+0226B         | »»    | hcirc;             | U+00125         | ߵ        |
| ggg;              | U+022D9         | »»    | hearts;            | U+02665         | ♥        |
| gimel;            | U+02137         | ܱ     | heartsuit;         | U+02665         | ♥        |
| GJcy;             | U+00403         | ܰ     | hellip;            | U+02026         | ...      |
| gjcy;             | U+00453         | ܰ     | hercon;            | U+022B9         | +        |
| gl;               | U+02277         | ≥≈    | Hfr;               | U+0210C         | ڻ        |
| gla;              | U+02AA5         | ××    | hfr;               | U+1D525         | ڻ        |
| glE;              | U+02A92         | ≈≈    | HilbertSpace;      | U+0210B         | ڢ        |
| glj;              | U+02AA4         | ≈≈    | hksearow;          | U+02925         | ↖        |
| gnap;             | U+02A8A         | ≈≈≈≈  | hkswarow;          | U+02926         | ↗        |
| gnapprox;         | U+02A8A         | ≈≈≈≈  | hoarr;             | U+021FF         | ↔        |
| gnE;              | U+02269         | ≈≈≈≈  | homtht;            | U+0223B         | ⤒        |
| gne;              | U+02A88         | ≈≈    | hookleftarrow;     | U+021A9         | ↔        |
| gneq;             | U+02A88         | ≈≈    | hookrightarrow;    | U+021AA         | ↪        |
| gneqq;            | U+02269         | ≈≈≈≈  | Hopf;              | U+0210D         | ߵ        |
| gnsim;            | U+022E7         | ≈≈≈≈  | hopf;              | U+1D559         | ߵ        |
| Gopf;             | U+1D53E         | Ӯ     | horbar;            | U+02015         | —        |
| gopf;             | U+1D558         | Ӯ     | HorizontalLine;    | U+02500         | —        |
| grave;            | U+00060         | ˊ     | Hscr;              | U+0210B         | ڢ        |
| GreaterEqual;     | U+02265         | ≥≈    | hscr;              | U+1D4BD         | ڻ        |
| GreaterEqualLess; | U+022DB         | ≈≈≈≈  | hslash;            | U+0210F         | ڻ        |
| GreaterFullEqual; | U+02267         | ≈≈≈≈  | Hstrok;            | U+00126         | ߵ        |

| Name            | Character(s) | Glyph | Name     | Character(s) | Glyph |
|-----------------|--------------|-------|----------|--------------|-------|
| hstrok;         | U+00127      | һ     | iocy;    | U+00451      | ë     |
| HumpDownHump;   | U+0224E      | ߂     | Iogon;   | U+0012E      | ି     |
| HumpEqual;      | U+0224F      | ସ     | iogon;   | U+0012F      | ି     |
| hybull;         | U+02043      | .     | Iopf;    | U+1D540      | ି     |
| hyphen;         | U+02010      | -     | iopf;    | U+1D55A      | ି     |
| Iacute;         | U+000CD      | ି     | Iota;    | U+00399      | ି     |
| Iacute          | U+000CD      | ି     | iota;    | U+003B9      | ି     |
| iacute;         | U+000ED      | ି     | iprod;   | U+02A3C      | ି     |
| iacute          | U+000ED      | ି     | iques;   | U+000BF      | ି     |
| ic;             | U+02063      |       | iques;   | U+000BF      | ି     |
| Icirc;          | U+000CE      | ି     | Iscr;    | U+02110      | ି     |
| Icirc           | U+000CE      | ି     | iscr;    | U+1D4BE      | ି     |
| icirc;          | U+000EE      | ି     | isin;    | U+02208      | ି     |
| icirc           | U+000EE      | ି     | isindot; | U+022F5      | ି     |
| Icy;            | U+00418      | ି     | isinE;   | U+022F9      | ି     |
| icy;            | U+00438      | ି     | isins;   | U+022F4      | ି     |
| Idot;           | U+00130      | ି     | isinsv;  | U+022F3      | ି     |
| IEcy;           | U+00415      | ି     | isinv;   | U+02208      | ି     |
| iecy;           | U+00435      | ି     | it;      | U+02062      |       |
| ieexcl;         | U+000A1      | ି     | Itilde;  | U+00128      | ି     |
| ieexcl          | U+000A1      | ି     | itilde;  | U+00129      | ି     |
| iff;            | U+021D4      | ⇒     | Iukcy;   | U+00406      | ି     |
| Ifr;            | U+02111      | ଜ     | iukcy;   | U+00456      | ି     |
| ifr;            | U+1D526      | ି     | Iuml;    | U+000CF      | ି     |
| Igrave;         | U+000CC      | ି     | Iuml;    | U+000CF      | ି     |
| Igrave          | U+000CC      | ି     | iuml;    | U+000EF      | ି     |
| igrave;         | U+000EC      | ି     | Jcirc;   | U+00134      | ି     |
| igrave          | U+000EC      | ି     | jcirc;   | U+00135      | ି     |
| ii;             | U+02148      | ି     | Jcy;     | U+00419      | ି     |
| iiiint;         | U+02A0C      | ିିି   | jcy;     | U+00439      | ି     |
| iiint;          | U+0222D      | ିିି   | Jfr;     | U+1D50D      | ଜ     |
| iinfin;         | U+029DC      | ିୟ    | jfr;     | U+1D527      | ି     |
| iiota;          | U+02129      | ି     | jmath;   | U+00237      | ି     |
| IJlig;          | U+00132      | ିି    | Jopf;    | U+1D541      | ି     |
| ijlig;          | U+00133      | ିି    | jopf;    | U+1D55B      | ି     |
| Im;             | U+02111      | ଜ     | Jscr;    | U+1D4A5      | ି     |
| Imacr;          | U+0012A      | ି     | jscr;    | U+1D4BF      | ି     |
| imacr;          | U+0012B      | ି     | Jsercy;  | U+00408      | ି     |
| image;          | U+02111      | ଜ     | jsercy;  | U+00458      | ି     |
| ImaginaryI;     | U+02148      | ି     | Jukcy;   | U+00404      | ି     |
| imagline;       | U+02110      | ି     | jukcy;   | U+00454      | ି     |
| imagpart;       | U+02111      | ଜ     | Kappa;   | U+0039A      | କ     |
| imath;          | U+00131      | ି     | kappa;   | U+003BA      | କ     |
| imof;           | U+022B7      | ିୟ    | kappav;  | U+003F0      | ି     |
| imped;          | U+001B5      | ି     | Kcedil;  | U+00136      | ି     |
| Implies;        | U+021D2      | ⇒     | kcedil;  | U+00137      | ି     |
| in;             | U+02208      | ି     | Kcy;     | U+0041A      | କ     |
| incare;         | U+02105      | ି     | kcy;     | U+0043A      | କ     |
| infin;          | U+0221E      | ିୟ    | Kfr;     | U+1D50E      | କ     |
| infintie;       | U+029DD      | ିୟ    | kfr;     | U+1D528      | ି     |
| inodot;         | U+00131      | ି     | kgreen;  | U+00138      | ି     |
| Int;            | U+0222C      | ିି    | KHcy;    | U+00425      | ି     |
| int;            | U+0222B      | ି     | khcy;    | U+00445      | ି     |
| intcal;         | U+022BA      | ି     | KJcy;    | U+0040C      | ି     |
| integers;       | U+02124      | ି     | kjcy;    | U+0045C      | ି     |
| Integral;       | U+0222B      | ି     | Kopf;    | U+1D542      | ି     |
| intercal;       | U+022BA      | ି     | kopf;    | U+1D55C      | ି     |
| Intersection;   | U+022C2      | ିି    | Kscr;    | U+1D4A6      | ି     |
| intlarhk;       | U+02A17      | ିି    | kscr;    | U+1D4C0      | ି     |
| intprod;        | U+02A3C      | ିି    | lAarr;   | U+021DA      | ିି    |
| InvisibleComma; | U+02063      |       | Lacute;  | U+00139      | ି     |
| InvisibleTimes; | U+02062      |       | lacute;  | U+0013A      | ି     |
| IOcy;           | U+00401      | ି     |          |              |       |

| Name                 | Character(s)    | Glyph | Name                 | Character(s)    | Glyph |
|----------------------|-----------------|-------|----------------------|-----------------|-------|
| laemptyv;            | U+029B4         | ∅     | LeftDownVectorBar;   | U+02959         | ↙     |
| lagran;              | U+02112         | ℒ     | LeftFloor;           | U+0230A         | └     |
| Lambda;              | U+0039B         | Λ     | leftharpoondown;     | U+021BD         | ⊤     |
| lambda;              | U+003BB         | λ     | leftharpoonup;       | U+021BC         | ⊤     |
| Lang;                | U+027EA         | «     | leftleftarrows;      | U+021C7         | ⤲     |
| lang;                | U+027E8         | ⟨     | LeftRightArrow;      | U+02194         | ⤳     |
| langd;               | U+02991         | ⟪     | Leftrightarrow;      | U+021D4         | ⤳     |
| langle;              | U+027E8         | ⟨     | Leftrightarrow;      | U+02194         | ⤳     |
| lap;                 | U+02A85         | ≈     | Leftrightarrows;     | U+021C6         | ⤳     |
| LaplaceTrf;          | U+02112         | ℒ     | Leftrighttharpoons;  | U+021CB         | ⤳     |
| laquo;               | U+000AB         | «     | Leftrightsquigarrow; | U+021AD         | ⤳     |
| laquo                | U+000AB         | «     | LeftRightVector;     | U+0294E         | ⤲     |
| Larr;                | U+0219E         | «     | LeftTee;             | U+022A3         | ⤠     |
| lArr;                | U+021D0         | ⇐     | LeftTeeArrow;        | U+021A4         | ⤲     |
| larr;                | U+02190         | ←     | LeftTeeVector;       | U+0295A         | ⤠     |
| larrb;               | U+021E4         | ↖     | leftthreetimes;      | U+022CB         | ⤢     |
| larrbfs;             | U+0291F         | ↔     | LeftTriangle;        | U+022B2         | ⤣     |
| larrfs;              | U+0291D         | ←     | LeftTriangleBar;     | U+029CF         | ⤣     |
| larrhk;              | U+021A9         | ↔     | LeftTriangleEqual;   | U+022B4         | ⤣     |
| larrlp;              | U+021AB         | ↔▫    | LeftUpDownVector;    | U+02951         | ⤠     |
| larrpl;              | U+02939         | ⌚     | LeftUpTeeVector;     | U+02960         | ⤠     |
| larrsim;             | U+02973         | ↭     | LeftUpVector;        | U+021BF         | ⤠     |
| larrtl;              | U+021A2         | ⤲     | LeftUpVectorBar;     | U+02958         | ⤠     |
| lat;                 | U+02AAB         | ⩳     | LeftVector;          | U+021BC         | ⤲     |
| lAtail;              | U+0291B         | ⤠     | LeftVectorBar;       | U+02952         | ⤠     |
| latail;              | U+02919         | ⤠     | lEg;                 | U+02A8B         | ⤠     |
| late;                | U+02AAD         | ⩳     | leg;                 | U+022DA         | ⤠     |
| lates;               | U+02AAD U+0FE00 | ⩳     | leq;                 | U+02264         | ⤠     |
| lbArr;               | U+0290E         | ⤠     | leqq;                | U+02266         | ⤠     |
| lbarr;               | U+0290C         | ⤠     | leqslant;            | U+02A7D         | ⤠     |
| lbbrk;               | U+02772         | {     | les;                 | U+02A7D         | ⤠     |
| lbrace;              | U+0007B         | {     | lescc;               | U+02AA8         | ⤠     |
| lbrack;              | U+0005B         | [     | lesdot;              | U+02A7F         | ⤠     |
| lbrke;               | U+0298B         | [     | lesdoto;             | U+02A81         | ⤠     |
| lbrksld;             | U+0298F         | ↓     | lesdotor;            | U+02A83         | ⤠     |
| lbrkslu;             | U+0298D         | [     | lesg;                | U+022DA U+0FE00 | ⤠     |
| Lcaron;              | U+0013D         | Ľ     | lesges;              | U+02A93         | ⤠     |
| lcaron;              | U+0013E         | ľ     | lessapprox;          | U+02A85         | ⤠     |
| Lcedil;              | U+0013B         | Ľ     | lessdot;             | U+022D6         | ⤠     |
| lcedil;              | U+0013C         | ↓     | lesseqgtr;           | U+022DA         | ⤠     |
| lceil;               | U+02308         | ⌈     | lesseqgtr;           | U+02A8B         | ⤠     |
| lcub;                | U+0007B         | {     | LessEqualGreater;    | U+022DA         | ⤠     |
| Lcy;                 | U+0041B         | Ĳ     | LessFullEqual;       | U+02266         | ⤠     |
| lcy;                 | U+0043B         | Ĳ     | LessGreater;         | U+02276         | ⤠     |
| ldca;                | U+02936         | ↔     | lessgtr;             | U+02276         | ⤠     |
| ldquo;               | U+0201C         | “     | LessLess;            | U+02AA1         | ⤠     |
| ldquor;              | U+0201E         | ”     | lesssim;             | U+02272         | ⤠     |
| ldrddhar;            | U+02967         | ⤠     | LessSlantEqual;      | U+02A7D         | ⤠     |
| ldrushar;            | U+0294B         | ⤠     | LessTilde;           | U+02272         | ⤠     |
| ldsh;                | U+021B2         | ⤠     | lfisht;              | U+0297C         | ⤠     |
| lE;                  | U+02266         | ≤     | lfloor;              | U+0230A         | ⤠     |
| le;                  | U+02264         | ≤     | Lfr;                 | U+1D50F         | Ľ     |
| LeftAngleBracket;    | U+027E8         | ⟨     | lfr;                 | U+1D529         | Ľ     |
| LeftArrow;           | U+02190         | ←     | lg;                  | U+02276         | ⤠     |
| Leftarrow;           | U+021D0         | ⇐     | lgE;                 | U+02A91         | ⤠     |
| leftarrow;           | U+02190         | ←     | lHar;                | U+02962         | ⤠     |
| LeftArrowBar;        | U+021E4         | ↖     | lhard;               | U+021BD         | ⤠     |
| LeftArrowRightArrow; | U+021C6         | ⤠     | lharu;               | U+021BC         | ⤠     |
| leftarrowtail;       | U+021A2         | ⤲     | lharul;              | U+0296A         | ⤠     |
| LeftCeiling;         | U+02308         | ⌈     | lblk;                | U+02584         | ■     |
| LeftDoubleBracket;   | U+027E6         | ⠇     | LJcy;                | U+00409         | Љ     |
| LeftDownTeeVector;   | U+02961         | ⠄     | ljcy;                | U+00459         | љ     |
| LeftDownVector;      | U+021C3         | ↓     | Ll;                  | U+022D8         | ⤠     |

| Name                | Character(s) | Glyph | Name           | Character(s)    | Glyph |
|---------------------|--------------|-------|----------------|-----------------|-------|
| ll;                 | U+0226A      | «     | Lstrokr;       | U+00141         | Ł     |
| llarr;              | U+021C7      | «=    | lstrok;        | U+00142         | ł     |
| llcorner;           | U+0231E      | „     | LT;            | U+0003C         | <     |
| Lleftarrow;         | U+021DA      | «≡    | LT             | U+0003C         | <     |
| llhard;             | U+0296B      | «=    | Lt;            | U+0226A         | «̄    |
| lltri;              | U+025FA      | △     | lt;            | U+0003C         | <     |
| Lmidot;             | U+0013F      | Ł     | ltcc;          | U+02AA6         | △     |
| lmidot;             | U+00140      | ł     | ltcir;         | U+02A79         | „̄    |
| lmoust;             | U+023B0      | ſ     | ltdot;         | U+022D6         | „̄    |
| lmoustache;         | U+023B0      | ſ     | lthree;        | U+022CB         | ×     |
| lnap;               | U+02A89      | „̄    | ltimes;        | U+022C9         | ×     |
| lnapprox;           | U+02A89      | „̄    | ltlarr;        | U+02976         | ≤̄    |
| lnE;                | U+02268      | „̄    | ltquest;       | U+02A7B         | ≤̄    |
| lne;                | U+02A87      | „̄    | ltri;          | U+025C3         | „̄    |
| lneq;               | U+02A87      | „̄    | ltrie;         | U+022B4         | △̄    |
| lneqq;              | U+02268      | „̄    | ltrif;         | U+025C2         | „̄    |
| lnsim;              | U+022E6      | „̄    | ltrPar;        | U+02996         | „̄    |
| loang;              | U+027EC      | (     | lurdshar;      | U+0294A         | „̄    |
| loarr;              | U+021FD      | ←     | luruhar;       | U+02966         | „̄    |
| lobrk;              | U+027E6      | ॥     | lvertneqq;     | U+02268 U+0FE00 | ≤̄    |
| LongLeftArrow;      | U+027F5      | ←     | lvnE;          | U+02268 U+0FE00 | ≤̄    |
| Longleftarrow;      | U+027F8      | «=    | macr;          | U+000AF         | —     |
| longleftarrow;      | U+027F5      | ←     | macr;          | U+000AF         | —     |
| LongLeftRightArrow; | U+027F7      | ↔     | male;          | U+02642         | ♂     |
| Longleftrightarrow; | U+027FA      | ↔     | malt;          | U+02720         | ✖     |
| longleftrightarrow; | U+027F7      | ↔     | maltese;       | U+02720         | ✖     |
| longmapsto;         | U+027FC      | →     | Map;           | U+02905         | ⤠     |
| LongRightArrow;     | U+027F6      | →     | map;           | U+021A6         | ⤠     |
| Longrightarrow;     | U+027F9      | →     | mapsto;        | U+021A6         | ⤠     |
| longrightarrow;     | U+027F6      | →     | mapstodown;    | U+021A7         | ⤡     |
| looparrowleft;      | U+021AB      | ⤠     | mapstoleft;    | U+021A4         | ⤠     |
| looparrowright;     | U+021AC      | ⤠     | mapstoup;      | U+021A5         | ⤡     |
| lopar;              | U+02985      | (     | marker;        | U+025AE         | ■     |
| Lopf;               | U+1D543      | Ł     | mcomma;        | U+02A29         | „̄    |
| lopf;               | U+1D55D      | ł     | Mcy;           | U+0041C         | M     |
| loplus;             | U+02A2D      | ⊕     | mcy;           | U+0043C         | M     |
| lotimes;            | U+02A34      | ⊗     | mdash;         | U+02014         | —     |
| lowast;             | U+02217      | *     | mDDot;         | U+0223A         | ⠋⠋    |
| lowbar;             | U+0005F      | —     | measuredangle; | U+02221         | ∠     |
| LowerLeftArrow;     | U+02199      | ↙     | MediumSpace;   | U+0205F         | ⠀     |
| LowerRightArrow;    | U+02198      | ↘     | Mellinfrf;     | U+02133         | ℳ     |
| loz;                | U+025CA      | ◊     | Mfr;           | U+1D510         | ℳ     |
| lozenge;            | U+025CA      | ◊     | mfr;           | U+1D52A         | ℳ     |
| lozf;               | U+029EB      | ♦     | mho;           | U+02127         | ଓ     |
| lpar;               | U+00028      | (     | micro;         | U+000B5         | μ     |
| lparlt;             | U+02993      | ⦿     | micro          | U+000B5         | μ     |
| lrarr;              | U+021C6      | ⤠     | mid;           | U+02223         |       |
| lrcorner;           | U+0231F      | „     | midast;        | U+0002A         | *     |
| lrhar;              | U+021CB      | ⤠     | midcir;        | U+02AF0         | ং     |
| lrhard;             | U+0296D      | ⤠     | middot;        | U+000B7         | ·     |
| lrm;                | U+0200E      | ▫     | middot         | U+000B7         | ·     |
| lrtri;              | U+022BF      | △     | minus;         | U+02212         | —     |
| lsaquo;             | U+02039      | 〈     | minusb;        | U+0229F         | ◻     |
| Lscr;               | U+02112      | Ł     | minusd;        | U+02238         | „̄    |
| lscr;               | U+1D4C1      | Ł     | minusdu;       | U+02A2A         | „̄    |
| Lsh;                | U+021B0      | ‘     | MinusPlus;     | U+02213         | 干     |
| lsh;                | U+021B0      | ‘     | mlcp;          | U+02ADB         | ▷     |
| lsim;               | U+02272      | ≤̄    | mldr;          | U+02026         | ...   |
| lsime;              | U+02A8D      | ≤̄    | mnplus;        | U+02213         | 干     |
| lsimg;              | U+02A8F      | „̄    | models;        | U+022A7         | _fk   |
| lsqb;               | U+0005B      | [     | Mopf;          | U+1D544         | ℳ     |
| lsquo;              | U+02018      | ‘     | mopf;          | U+1D55E         | m     |
| lsquor;             | U+0201A      | ,     |                |                 |       |

| Name                   | Character(s)    | Glyph | Name                  | Character(s)    | Glyph |
|------------------------|-----------------|-------|-----------------------|-----------------|-------|
| mp;                    | U+02213         | 〒     | nGt;                  | U+0226B U+020D2 | ↗     |
| Mscr;                  | U+02133         | ℳ     | ngt;                  | U+0226F         | ↗     |
| mscr;                  | U+1D4C2         | ℳ     | ngtr;                 | U+0226F         | ↗     |
| mstpos;                | U+0223E         | ˜     | nGtv;                 | U+0226B U+00338 | ↗     |
| Mu;                    | U+0039C         | ℳ     | nhArr;                | U+021CE         | ↔     |
| mu;                    | U+003BC         | μ     | nharr;                | U+021AE         | ↔     |
| multimap;              | U+022B8         | →◦    | nhpar;                | U+02AF2         | ⤠     |
| mumap;                 | U+022B8         | →◦    | ni;                   | U+0220B         | ⤢     |
| nabla;                 | U+02207         | ∇     | nis;                  | U+022FC         | ⤢     |
| Nacute;                | U+00143         | Ń     | nisd;                 | U+022FA         | ⤢     |
| nacute;                | U+00144         | ń     | niv;                  | U+0220B         | ⤢     |
| nang;                  | U+02220 U+020D2 | ݁     | NJcy;                 | U+0040A         | ܂     |
| nap;                   | U+02249         | ܂     | njcy;                 | U+0045A         | ܂     |
| napE;                  | U+02A70 U+00338 | ܂܂    | nlArr;                | U+021CD         | ⤠     |
| napid;                 | U+0224B U+00338 | ܂܂    | nlarr;                | U+0219A         | ⤠     |
| napos;                 | U+00149         | ܂     | nldr;                 | U+02025         | ..    |
| napprox;               | U+02249         | ܂     | nlE;                  | U+02266 U+00338 | ܂     |
| natur;                 | U+0266E         | ܂     | nle;                  | U+02270         | ܂     |
| natural;               | U+0266E         | ܂     | nLeftarrow;           | U+021CD         | ⤠     |
| naturals;              | U+02115         | ܂     | nleftarrow;           | U+0219A         | ⤠     |
| nbsp;                  | U+000A0         | ⠀     | nLeftrightarrow;      | U+021CE         | ⤠     |
| nbsp                   | U+000A0         | ⠀     | nleftrightarrow;      | U+021AE         | ⤠     |
| nbump;                 | U+0224E U+00338 | ܂     | nleq;                 | U+02270         | ܂     |
| nbumper;               | U+0224F U+00338 | ܂     | nleqq;                | U+02266 U+00338 | ܂     |
| ncap;                  | U+02A43         | ܂     | nleqslant;            | U+02A7D U+00338 | ܂     |
| Ncaron;                | U+00147         | ܂     | nles;                 | U+02A7D U+00338 | ܂     |
| ncaron;                | U+00148         | ܂     | nless;                | U+0226E         | ܂     |
| Ncedil;                | U+00145         | ܂     | nLl;                  | U+022D8 U+00338 | ܂܂    |
| ncedil;                | U+00146         | ܂     | nlsim;                | U+02274         | ܂     |
| ncong;                 | U+02247         | ܂܂    | nLt;                  | U+0226A U+020D2 | ܂܂    |
| ncongdot;              | U+02A6D U+00338 | ܂܂    | nlt;                  | U+0226E         | ܂     |
| ncup;                  | U+02A42         | ܂     | nltri;                | U+022EA         | ܂     |
| Ncy;                   | U+0041D         | ܂     | nltrie;               | U+022EC         | ܂     |
| ncy;                   | U+0043D         | ܂     | nLtv;                 | U+0226A U+00338 | ܂܂    |
| ndash;                 | U+02013         | –     | nmid;                 | U+02224         | ܂     |
| ne;                    | U+02260         | ≠     | NoBreak;              | U+02060         |       |
| nearhk;                | U+02924         | ܂     | NonBreakingSpace;     | U+000A0         |       |
| neArr;                 | U+021D7         | ⤠     | Nopf;                 | U+02115         | ܂     |
| nearr;                 | U+02197         | ⤠     | nopf;                 | U+1D55F         | ܂     |
| nearrow;               | U+02197         | ⤠     | Not;                  | U+02AEC         | ܂     |
| nedot;                 | U+02250 U+00338 | ܂     | not;                  | U+000AC         | ܂     |
| NegativeMediumSpace;   | U+0200B         |       | not                   | U+000AC         | ܂     |
| NegativeThickSpace;    | U+0200B         |       | NotCongruent;         | U+02262         | ܂     |
| NegativeThinSpace;     | U+0200B         |       | NotCupCap;            | U+0226D         | ܂     |
| NegativeVeryThinSpace; | U+0200B         |       | NotDoubleVerticalBar; | U+02226         | ܂     |
| nequiv;                | U+02262         | ܂     | NotElement;           | U+02209         | ܂     |
| nesear;                | U+02928         | ܂     | NotEqual;             | U+02260         | ܂     |
| nesim;                 | U+02242 U+00338 | ܂     | NotEqualTilde;        | U+02242 U+00338 | ܂     |
| NestedGreaterGreater;  | U+0226B         | ⤠     | NotExists;            | U+02204         | ܂     |
| NestedLessLess;        | U+0226A         | ⤠     | NotGreater;           | U+0226F         | ܂     |
| NewLine;               | U+000A          | ܂     | NotGreaterEqual;      | U+02271         | ܂     |
| nexist;                | U+02204         | ܂     | NotGreaterFullEqual;  | U+02267 U+00338 | ܂     |
| nexists;               | U+02204         | ܂     | NotGreaterGreater;    | U+0226B U+00338 | ܂     |
| Nfr;                   | U+1D511         | ܂     | NotGreaterLess;       | U+02279         | ܂     |
| nfr;                   | U+1D52B         | ܂     | NotGreaterSlantEqual; | U+02A7E U+00338 | ܂     |
| ngE;                   | U+02267 U+00338 | ܂     | NotGreaterTilde;      | U+02275         | ܂     |
| nge;                   | U+02271         | ܂     | NotHumpDownHump;      | U+0224E U+00338 | ܂     |
| ngeq;                  | U+02271         | ܂     | NotHumpEqual;         | U+0224F U+00338 | ܂     |
| ngeqq;                 | U+02267 U+00338 | ܂     | notin;                | U+02209         | ܂     |
| ngeqlant;              | U+02A7E U+00338 | ܂     | notindot;             | U+022F5 U+00338 | ܂     |
| nges;                  | U+02A7E U+00338 | ܂     | notinE;               | U+022F9 U+00338 | ܂     |
| nGg;                   | U+022D9 U+00338 | ܂܂    | notinva;              | U+02209         | ܂     |
| ngsim;                 | U+02275         | ܂     | notinvb;              | U+022F7         | ܂     |

| Name                     | Character(s)    | Glyph | Name              | Character(s)    | Glyph |
|--------------------------|-----------------|-------|-------------------|-----------------|-------|
| notinvc;                 | U+022F6         | Ē     | nshortmid;        | U+02224         | ՚     |
| NotLeftTriangle;         | U+022EA         | ↗     | nshortparallel;   | U+02226         | ՚     |
| NotLeftTriangleBar;      | U+029CF U+00338 | ↗     | nsim;             | U+02241         | ݔ     |
| NotLeftTriangleEqual;    | U+022EC         | ܔ     | nsime;            | U+02244         | ݔ     |
| NotLess;                 | U+0226E         | ܔ     | nsimeq;           | U+02244         | ݔ     |
| NotLessEqual;            | U+02270         | ܔ     | nsmid;            | U+02224         | ՚     |
| NotLessGreater;          | U+02278         | ܔ     | nspar;            | U+02226         | ՚     |
| NotLessLess;             | U+0226A U+00338 | ܔ     | nsqsube;          | U+022E2         | ܔ     |
| NotLessSlantEqual;       | U+02A7D U+00338 | ܔ     | nsqsupe;          | U+022E3         | ܔ     |
| NotLessTilde;            | U+02274         | ܔ     | nsub;             | U+02284         | ܔ     |
| NotNestedGreaterGreater; | U+02AA2 U+00338 | ܔ     | nsubE;            | U+02AC5 U+00338 | ܔ     |
| NotNestedLessLess;       | U+02AA1 U+00338 | ܔ     | nsube;            | U+02288         | ܔ     |
| notni;                   | U+0220C         | ܔ     | nsubset;          | U+02282 U+020D2 | ܔ     |
| notniva;                 | U+0220C         | ܔ     | nsubseteq;        | U+02288         | ܔ     |
| notnivb;                 | U+022FE         | ܔ     | nsubeteqq;        | U+02AC5 U+00338 | ܔ     |
| notnivc;                 | U+022FD         | ܔ     | nsucc;            | U+02281         | ݔ     |
| NotPrecedes;             | U+02280         | ܔ     | nsuccseq;         | U+02AB0 U+00338 | ݔ     |
| NotPrecedesEqual;        | U+02AAF U+00338 | ܔ     | nsup;             | U+02285         | ܔ     |
| NotPrecedesSlantEqual;   | U+022E0         | ܔ     | nsupE;            | U+02AC6 U+00338 | ܔ     |
| NotReverseElement;       | U+0220C         | ܔ     | nsupe;            | U+02289         | ܔ     |
| NotRightTriangle;        | U+022EB         | ܔ     | nsupset;          | U+02283 U+020D2 | ܔ     |
| NotRightTriangleBar;     | U+029D0 U+00338 | ܔ     | nsupseteq;        | U+02289         | ܔ     |
| NotRightTriangleEqual;   | U+022ED         | ܔ     | nsupseteqq;       | U+02AC6 U+00338 | ܔ     |
| NotSquareSubset;         | U+0228F U+00338 | ܔ     | ntgl;             | U+02279         | ܔ     |
| NotSquareSubsetEqual;    | U+022E2         | ܔ     | Ntilde;           | U+000D1         | ܔ     |
| NotSquareSuperset;       | U+02290 U+00338 | ܔ     | Ntilde;           | U+000D1         | ܔ     |
| NotSquareSupersetEqual;  | U+022E3         | ܔ     | ntilde;           | U+000F1         | ܔ     |
| NotSubset;               | U+02282 U+020D2 | ܔ     | ntlg;             | U+02278         | ܔ     |
| NotSubsetEqual;          | U+02288         | ܔ     | ntriangleleft;    | U+022EA         | ܔ     |
| NotSucceeds;             | U+02281         | ݔ     | ntrianglelefteq;  | U+022EC         | ܔ     |
| NotSucceedsEqual;        | U+02AB0 U+00338 | ܔ     | ntriangleright;   | U+022EB         | ܔ     |
| NotSucceedsSlantEqual;   | U+022E1         | ݔ     | ntrianglerighteq; | U+022ED         | ܔ     |
| NotSucceedsTilde;        | U+0227F U+00338 | ܔ     | Nu;               | U+0039D         | ܔ     |
| NotSuperset;             | U+02283 U+020D2 | ܔ     | nu;               | U+003BD         | ܔ     |
| NotSupersetEqual;        | U+02289         | ܔ     | num;              | U+00023         | ܔ     |
| NotTilde;                | U+02241         | ݔ     | numero;           | U+02116         | ܔ     |
| NotTildeEqual;           | U+02244         | ݔ     | numsp;            | U+02007         | ܔ     |
| NotTildeFullEqual;       | U+02247         | ݔ     | nvap;             | U+0224D U+020D2 | ݔ     |
| NotTildeTilde;           | U+02249         | ݔ     | nVDash;           | U+022AF         | ܔ     |
| NotVerticalBar;          | U+02224         | ܔ     | nVdash;           | U+022AE         | ܔ     |
| npar;                    | U+02226         | ܔ     | nvDash;           | U+022AD         | ܔ     |
| nparallel;               | U+02226         | ܔ     | nvdash;           | U+022AC         | ܔ     |
| nparsl;                  | U+02AFD U+020E5 | ܔ     | nvge;             | U+02265 U+020D2 | ݔ     |
| npart;                   | U+02202 U+00338 | ܔ     | nvgt;             | U+0003E U+020D2 | ݔ     |
| npolint;                 | U+02A14         | ܔ     | nvHarr;           | U+02904         | ܔ     |
| npr;                     | U+02280         | ܔ     | nvinf;            | U+029DE         | ܔ     |
| nprcue;                  | U+022E0         | ݔ     | nvlArr;           | U+02902         | ܔ     |
| npre;                    | U+02AAF U+00338 | ܔ     | nvle;             | U+02264 U+020D2 | ܔ     |
| nprec;                   | U+02280         | ܔ     | nvlt;             | U+0003C U+020D2 | ܔ     |
| npreced;                 | U+02AAF U+00338 | ܔ     | nvltrie;          | U+022B4 U+020D2 | ܔ     |
| nrArr;                   | U+021CF         | ܔ     | nvrArr;           | U+02903         | ܔ     |
| nrarr;                   | U+0219B         | ܔ     | nvrtrie;          | U+022B5 U+020D2 | ܔ     |
| nrarrc;                  | U+02933 U+00338 | ݔ     | nvsim;            | U+0223C U+020D2 | ܔ     |
| nrarrw;                  | U+0219D U+00338 | ݔ     | nwarhk;           | U+02923         | ܔ     |
| nRightarrow;             | U+021CF         | ܔ     | nwArr;            | U+021D6         | ܔ     |
| nrightarrow;             | U+0219B         | ܔ     | nwarr;            | U+02196         | ܔ     |
| nrtri;                   | U+022EB         | ܔ     | nwarrown;         | U+02196         | ܔ     |
| nrtrie;                  | U+022ED         | ܔ     | nwnear;           | U+02927         | ܔ     |
| nsc;                     | U+02281         | ݔ     | Oacute;           | U+000D3         | ܔ     |
| nsccue;                  | U+022E1         | ݔ     | Oacute;           | U+000D3         | ܔ     |
| nsce;                    | U+02AB0 U+00338 | ܔ     | oacute;           | U+000F3         | ܔ     |
| Nscr;                    | U+1D4A9         | ܔ     | oacute;           | U+000F3         | ܔ     |
| nscr;                    | U+1D4C3         | ܔ     |                   |                 |       |

| Name                  | Character(s) | Glyph | Name             | Character(s) | Glyph     |
|-----------------------|--------------|-------|------------------|--------------|-----------|
| oast;                 | U+0229B      | ⊗     | Oscr;            | U+1D4AA      | ø         |
| ocir;                 | U+0229A      | ◎     | oscr;            | U+02134      | ø         |
| Ocirc;                | U+000D4      | Ӯ     | Oslash;          | U+000D8      | ø         |
| Ocirc                 | U+000D4      | Ӯ     | Oslash           | U+000D8      | ø         |
| ocirc;                | U+000F4      | ӻ     | oslash;          | U+000F8      | ø         |
| ocirc                 | U+000F4      | ӻ     | oslash           | U+000F8      | ø         |
| Ocy;                  | U+0041E      | Ӱ     | osol;            | U+02298      | ∅         |
| ocy;                  | U+0043E      | ӱ     | Otilde;          | U+000D5      | ӷ         |
| odash;                | U+0229D      | ⊖     | Otilde           | U+000D5      | ӷ         |
| Odblac;               | U+00150      | ӹ     | otilde;          | U+000F5      | Ӹ         |
| odblac;               | U+00151      | Ӻ     | otilde           | U+000F5      | Ӹ         |
| odiv;                 | U+02A38      | ⊕     | Otimes;          | U+02A37      | ⊗         |
| odot;                 | U+02299      | ⊙     | otimes;          | U+02297      | ⊗         |
| odsold;               | U+029BC      | ⊗     | otimesas;        | U+02A36      | ⊗         |
| OElig;                | U+00152      | Œ     | Ouml;            | U+000D6      | Ӧ         |
| oelig;                | U+00153      | œ     | Ouml             | U+000D6      | Ӧ         |
| ofcir;                | U+029BF      | ◉     | ouml;            | U+000F6      | ö         |
| Ofr;                  | U+1D512      | Ӯ     | ouml             | U+000F6      | ö         |
| ofr;                  | U+1D52C      | ø     | ovbar;           | U+0233D      | ◊         |
| ogon;                 | U+002DB      | ‘     | OverBar;         | U+0203E      | —         |
| Ograve;               | U+000D2      | Ӯ     | OverBrace;       | U+023DE      | ⏜         |
| Ograve                | U+000D2      | Ӯ     | OverBracket;     | U+023B4      | ⏝         |
| ograve;               | U+000F2      | ò     | OverParenthesis; | U+023DC      | ⏝         |
| ograve                | U+000F2      | ò     | par;             | U+02225      |           |
| ogt;                  | U+029C1      | ⊗     | para;            | U+000B6      | ¶         |
| ohbar;                | U+029B5      | ⊖     | para             | U+000B6      | ¶         |
| ohm;                  | U+003A9      | Ω     | parallel;        | U+02225      |           |
| oint;                 | U+0222E      | ƒ     | parsim;          | U+02AF3      | ₩         |
| olarr;                | U+021BA      | ○     | parsl;           | U+02AFD      | //        |
| olcir;                | U+029BE      | ◎     | part;            | U+02202      | ð         |
| olcross;              | U+029BB      | ⊗     | PartialD;        | U+02202      | ð         |
| oline;                | U+0203E      | —     | Pcy;             | U+0041F      | ∏         |
| olt;                  | U+029C0      | ⊗     | pcy;             | U+0043F      | ∏         |
| Omacr;                | U+0014C      | Ӯ     | percnt;          | U+00025      | %         |
| omacr;                | U+0014D      | ö     | period;          | U+0002E      | .         |
| Omega;                | U+003A9      | Ω     | permil;          | U+02030      | ‰         |
| omega;                | U+003C9      | ω     | perp;            | U+022A5      | ⊥         |
| Omicron;              | U+0039F      | Ӯ     | pertenk;         | U+02031      | ‰‰        |
| omicron;              | U+003BF      | ø     | Pfr;             | U+1D513      | ₱         |
| omid;                 | U+029B6      | ◑     | pfr;             | U+1D52D      | ₱         |
| ominus;               | U+02296      | ⊖     | Phi;             | U+003A6      | Φ         |
| Oopf;                 | U+1D546      | ∅     | phi;             | U+003C6      | φ         |
| oopf;                 | U+1D560      | ∅     | phiv;            | U+003D5      | φ         |
| opar;                 | U+029B7      | ∅∅    | phmmat;          | U+02133      | ℳ         |
| OpenCurlyDoubleQuote; | U+0201C      | “     | phone;           | U+0260E      | ☎         |
| OpenCurlyQuote;       | U+02018      | ‘     | Pi;              | U+003A0      | ∏         |
| operp;                | U+029B9      | ∅     | pi;              | U+003C0      | π         |
| oplus;                | U+02295      | ⊕     | pitchfork;       | U+022D4      | pitchfork |
| Or;                   | U+02A54      | ∨     | piv;             | U+003D6      | ϖ         |
| or;                   | U+02228      | ∨     | planck;          | U+0210F      | ℏ         |
| orarr;                | U+021BB      | ○     | planckh;         | U+0210E      | h         |
| ord;                  | U+02A5D      | ∨     | plankv;          | U+0210F      | ℏ         |
| order;                | U+02134      | ◦     | plus;            | U+0002B      | +         |
| orderof;              | U+02134      | ◦     | plusacir;        | U+02A23      | †         |
| ordf;                 | U+000AA      | ª     | plusb;           | U+0229E      | 田         |
| ordf                  | U+000AA      | ª     | pluscir;         | U+02A22      | ‡         |
| ordm;                 | U+000BA      | º     | plusdo;          | U+02214      | ‡         |
| ordm                  | U+000BA      | º     | plusdu;          | U+02A25      | ‡         |
| origof;               | U+022B6      | ◦•    | pluse;           | U+02A72      | ±         |
| oror;                 | U+02A56      | ∨     | PlusMinus;       | U+000B1      | ±         |
| orslope;              | U+02A57      | ∨     | plusmn;          | U+000B1      | ±         |
| orv;                  | U+02A5B      | ∨     | plusmn           | U+000B1      | ±         |
| oS;                   | U+024C8      | ⌚     | plussim;         | U+02A26      | ±         |

| Name                | Character(s) | Glyph | Name       | Character(s)    | Glyph |
|---------------------|--------------|-------|------------|-----------------|-------|
| plustwo;            | U+02A27      | ‡     | quot       | U+00022         | "     |
| pm;                 | U+000B1      | ±     | rAarr;     | U+021DB         | ⇒     |
| Poincareplane;      | U+0210C      | §     | race;      | U+0223D U+00331 | ݂     |
| pointint;           | U+02A15      | ƒ     | Racute;    | U+00154         | Ŕ     |
| Popf;               | U+02119      | ߵ     | racute;    | U+00155         | ŕ     |
| popf;               | U+1D561      | ߵ     | radic;     | U+0221A         | √     |
| pound;              | U+000A3      | ߵ     | raemptyv;  | U+029B3         | ܽ     |
| pound               | U+000A3      | ߵ     | Rang;      | U+027EB         | »     |
| Pr;                 | U+02ABB      | ߵ     | rang;      | U+027E9         | 〉     |
| pr;                 | U+0227A      | ߵ     | rangd;     | U+02992         | 〉     |
| prap;               | U+02AB7      | ߵ     | range;     | U+029A5         | ݂     |
| prcue;              | U+0227C      | ߵ     | rangle;    | U+027E9         | 〉     |
| prE;                | U+02AB3      | ߵ     | raquo;     | U+000BB         | »     |
| pre;                | U+02AAF      | ߵ     | raquo      | U+000BB         | »     |
| prec;               | U+0227A      | ߵ     | Rarr;      | U+021A0         | ⤠     |
| precapprox;         | U+02AB7      | ߵ     | rArr;      | U+021D2         | ⤡     |
| preccurlyeq;        | U+0227C      | ߵ     | rarr;      | U+02192         | ⤢     |
| Precedes;           | U+0227A      | ߵ     | rarrap;    | U+02975         | ⤣     |
| PrecedesEqual;      | U+02AAF      | ߵ     | rarrb;     | U+021E5         | ⤤     |
| PrecedesSlantEqual; | U+0227C      | ߵ     | rarrbf;    | U+02920         | ⤤     |
| PrecedesTilde;      | U+0227E      | ߵ     | rarrc;     | U+02933         | ⤤     |
| preceq;             | U+02AAF      | ߵ     | rarrfs;    | U+0291E         | ⤢     |
| precnapprox;        | U+02AB9      | ߵߵ    | rarrhk;    | U+021AA         | ⤤     |
| precneqq;           | U+02AB5      | ߵߵ    | rarrlp;    | U+021AC         | ⤤     |
| precnsim;           | U+022E8      | ߵߵ    | rarrpl;    | U+02945         | ⤤     |
| precsim;            | U+0227E      | ߵߵ    | rarrsim;   | U+02974         | ⤤     |
| Prime;              | U+02033      | "     | Rarrtl;    | U+02916         | ⤣     |
| prime;              | U+02032      | '     | rarrtl;    | U+021A3         | ⤤     |
| primes;             | U+02119      | ߵ     | rarrw;     | U+0219D         | ⤤     |
| prnap;              | U+02AB9      | ߵߵ    | rAtail;    | U+0291C         | ⤤     |
| prnE;               | U+02AB5      | ߵߵ    | ratail;    | U+0291A         | ⤤     |
| prnsim;             | U+022E8      | ߵߵ    | ratio;     | U+02236         | :     |
| prod;               | U+0220F      | Π     | rationals; | U+0211A         | ܖ     |
| Product;            | U+0220F      | Π     | RBarr;     | U+02910         | ⤣     |
| profalar;           | U+0232E      | ܧ     | rBarr;     | U+0290F         | ⤢     |
| proffline;          | U+02312      | ܨ     | rbarr;     | U+0290D         | ⤢     |
| profsurf;           | U+02313      | ܨ     | rbbrk;     | U+02773         | ܨ     |
| prop;               | U+0221D      | ܧ     | rbrace;    | U+0007D         | ܨ     |
| Proportion;         | U+02237      | ::    | rbrack;    | U+0005D         | ܨ     |
| Proportional;       | U+0221D      | ܧ     | rbrke;     | U+0298C         | ܨ     |
| proto;              | U+0221D      | ܧ     | rbrksld;   | U+0298E         | ܨ     |
| prsim;              | U+0227E      | ܨ     | rbrkslu;   | U+02990         | ܨ     |
| prurel;             | U+022B0      | ܧ     | Rcaron;    | U+00158         | ܨ     |
| Pscr;               | U+1D4AB      | ܧ     | rcaron;    | U+00159         | ܨ     |
| pscr;               | U+1D4C5      | ܧ     | Rcedil;    | U+00156         | ܨ     |
| Psi;                | U+003A8      | ܧ     | rcedil;    | U+00157         | ܨ     |
| psi;                | U+003C8      | ܧ     | rceil;     | U+02309         | ܨ     |
| puncsp;             | U+02008      |       | rcub;      | U+0007D         | ܨ     |
| Qfr;                | U+1D514      | ܧ     | Rcy;       | U+00420         | ܖ     |
| qfr;                | U+1D52E      | ܧ     | rcy;       | U+00440         | ܖ     |
| qint;               | U+02A0C      | ܨܨܨ   | rdca;      | U+02937         | ܨ     |
| Qopf;               | U+0211A      | ܧ     | rdldhar;   | U+02969         | ܨ     |
| qopf;               | U+1D562      | ܧ     | rdquo;     | U+0201D         | "     |
| qprime;             | U+02057      | ܨܨܨ   | rdquor;    | U+0201D         | "     |
| Qscr;               | U+1D4AC      | ܧ     | rdsh;      | U+021B3         | ܨ     |
| qscr;               | U+1D4C6      | ܧ     | Re;        | U+0211C         | ܨ     |
| quaternions;        | U+0210D      | ܧ     | real;      | U+0211C         | ܨ     |
| quatint;            | U+02A16      | ܧ     | realine;   | U+0211B         | ܨ     |
| quest;              | U+0003F      | ?     | realpart;  | U+0211C         | ܨ     |
| quested;            | U+0225F      | ܧ     | reals;     | U+0211D         | ܨ     |
| QUOT;               | U+00022      | "     | rect;      | U+025AD         | ܨ     |
| QUOT                | U+00022      | "     | REG;       | U+000AE         | ܧ     |
| quot;               | U+00022      | "     | REG        | U+000AE         | ܧ     |

| Name                  | Character(s) | Glyph | Name          | Character(s) | Glyph |
|-----------------------|--------------|-------|---------------|--------------|-------|
| reg;                  | U+000AE      | ®     | rotimes;      | U+02A35      | ⊗     |
| reg                   | U+000AE      | ®     | RoundImplies; | U+02970      | ⇒     |
| ReverseElement;       | U+0220B      | ⊸     | rpar;         | U+00029      | )     |
| ReverseEquilibrium;   | U+021CB      | ⊶     | rpargt;       | U+02994      | ⊷     |
| ReverseUpEquilibrium; | U+0296F      | ⊵     | rppoint;      | U+02A12      | ƒ     |
| rfisht;               | U+0297D      | ⤢     | rrarr;        | U+021C9      | ⤣     |
| rfloor;               | U+0230B      | ⤠     | Rrightarrow;  | U+021DB      | ⤧     |
| Rfr;                  | U+0211C      | ⤡     | rsaquo;       | U+0203A      | ⤢     |
| rfr;                  | U+1D52F      | ⤢     | Rscr;         | U+0211B      | ⤨     |
| rHar;                 | U+02964      | ⤣     | rscr;         | U+1D4C7      | ⤩     |
| rhard;                | U+021C1      | ⤤     | Rsh;          | U+021B1      | ⤪     |
| rharu;                | U+021C0      | ⤥     | rsh;          | U+021B1      | ⤪     |
| rharul;               | U+0296C      | ⤦     | rsqb;         | U+0005D      | ]}⤦   |
| Rho;                  | U+003A1      | ⤧     | rsquo;        | U+02019      | ,     |
| rho;                  | U+003C1      | ⤧     | rsquor;       | U+02019      | ,     |
| rhov;                 | U+003F1      | ⤧     | rthree;       | U+022CC      | ⤦     |
| RightAngleBracket;    | U+027E9      | ⤩     | rtimes;       | U+022CA      | ⤦     |
| RightArrow;           | U+02192      | ⤧     | rtri;         | U+025B9      | ⤧     |
| Rightarrow;           | U+021D2      | ⤧     | rtrie;        | U+022B5      | ⤧     |
| rightarrow;           | U+02192      | ⤧     | rtrif;        | U+025B8      | ⤧     |
| RightArrowBar;        | U+021E5      | ⤧     | rtriltri;     | U+029CE      | ⤧     |
| RightArrowLeftArrow;  | U+021C4      | ⤧     | RuleDelayed;  | U+029F4      | ⤧     |
| rightarrowtail;       | U+021A3      | ⤧     | ruluhar;      | U+02968      | ⤦     |
| RightCeiling;         | U+02309      | ⤠     | rx;           | U+0211E      | ⤨     |
| RightDoubleBracket;   | U+027E7      | ⤩     | Sacute;       | U+0015A      | ́     |
| RightDownTeeVector;   | U+0295D      | ⤤     | sacute;       | U+0015B      | ́     |
| RightDownVector;      | U+021C2      | ⤤     | sbquo;        | U+0201A      | ,     |
| RightDownVectorBar;   | U+02955      | ⤤     | Sc;           | U+02ABC      | ⤨     |
| RightFloor;           | U+0230B      | ⤠     | sc;           | U+0227B      | ⤨     |
| righttharpoondown;    | U+021C1      | ⤧     | scap;         | U+02AB8      | ⤨     |
| righttharpoonup;      | U+021C0      | ⤧     | Scaron;       | U+00160      | ſ     |
| rightleftarrows;      | U+021C4      | ⤧     | scaron;       | U+00161      | ſ     |
| rightleftharpoons;    | U+021CC      | ⤧     | sccue;        | U+0227D      | ⤨     |
| rightrightarrows;     | U+021C9      | ⤧     | scE;          | U+02AB4      | ⤨     |
| rightsquigarrow;      | U+0219D      | ⤧     | sce;          | U+02AB0      | ⤨     |
| RightTee;             | U+022A2      | ⤤     | Scedil;       | U+0015E      | §     |
| RightTeeArrow;        | U+021A6      | ⤧     | scedil;       | U+0015F      | §     |
| RightTeeVector;       | U+0295B      | ⤧     | Scirc;        | U+0015C      | ſ     |
| rightthreetimes;      | U+022CC      | ⤦     | scirc;        | U+0015D      | ſ     |
| RightTriangle;        | U+022B3      | ⤧     | scnap;        | U+02ABA      | ⤨     |
| RightTriangleBar;     | U+029D0      | ⤧     | scnE;         | U+02AB6      | ⤨     |
| RightTriangleEqual;   | U+022B5      | ⤧     | scnsim;       | U+022E9      | ⤨     |
| RightUpDownVector;    | U+0294F      | ⤤     | scpolint;     | U+02A13      | ſ     |
| RightUpTeeVector;     | U+0295C      | ⤤     | scsim;        | U+0227F      | ⤨     |
| RightUpVector;        | U+021BE      | ⤤     | Scy;          | U+00421      | C     |
| RightUpVectorBar;     | U+02954      | ⤤     | scy;          | U+00441      | c     |
| RightVector;          | U+021C0      | ⤧     | sdot;         | U+022C5      | •     |
| RightVectorBar;       | U+02953      | ⤧     | sdotb;        | U+022A1      | □     |
| ring;                 | U+002DA      | ⠄     | sdote;        | U+02A66      | ⠇     |
| risingdotseq;         | U+02253      | ⠇     | searhk;       | U+02925      | ⤨     |
| rlarr;                | U+021C4      | ⤧     | seArr;        | U+021D8      | ⤨     |
| rlhar;                | U+021CC      | ⤧     | searr;        | U+02198      | ⤨     |
| rlm;                  | U+0200F      | ⠀     | searrow;      | U+02198      | ⤨     |
| rmoust;               | U+023B1      | ⠇     | sect;         | U+000A7      | §     |
| rmoustache;           | U+023B1      | ⠇     | sect          | U+000A7      | §     |
| rnmid;                | U+02AEE      | ⠄     | semi;         | U+0003B      | ;     |
| roang;                | U+027ED      | ⠄     | seswar;       | U+02929      | ⤨     |
| roarr;                | U+021FE      | ⤧     | setminus;     | U+02216      | ＼     |
| robrik;               | U+027E7      | ⠄     | setmn;        | U+02216      | ＼     |
| ropar;                | U+02986      | ⠄     | sextr;        | U+02736      | *     |
| Ropf;                 | U+0211D      | ⠄     | Sfr;          | U+1D516      | ⠄     |
| ropf;                 | U+1D563      | ⠄     | sfr;          | U+1D530      | ⠄     |
| roplus;               | U+02A2E      | ⠄     | sfrown;       | U+02322      | ⠄     |

| Name             | Character(s)    | Glyph | Name                 | Character(s) | Glyph              |
|------------------|-----------------|-------|----------------------|--------------|--------------------|
| sharp;           | U+0266F         | #     | square;              | U+025A1      | □                  |
| SHChcy;          | U+00429         | III   | SquareIntersection;  | U+02293      | □                  |
| shchcy;          | U+00449         | III   | SquareSubset;        | U+0228F      | □                  |
| SHcy;            | U+00428         | III   | SquareSubsetEqual;   | U+02291      | □                  |
| shcy;            | U+00448         | III   | SquareSuperset;      | U+02290      | □                  |
| ShortDownArrow;  | U+02193         | ↓     | SquareSupersetEqual; | U+02292      | □                  |
| ShortLeftArrow;  | U+02190         | ←     | SquareUnion;         | U+02294      | □                  |
| shortmid;        | U+02223         |       | squaref;             | U+025AA      | ▪                  |
| shortparallel;   | U+02225         |       | squf;                | U+025AA      | ▪                  |
| ShortRightArrow; | U+02192         | →     | srarr;               | U+02192      | →                  |
| ShortUpArrow;    | U+02191         | ↑     | Sscr;                | U+1D4AE      | ſ                  |
| shy;             | U+000AD         |       | sscr;                | U+1D4C8      | ſ                  |
| shy              | U+000AD         |       | ssetmn;              | U+02216      | ＼                  |
| Sigma;           | U+003A3         | Σ     | ssmile;              | U+02323      | ‿                  |
| sigma;           | U+003C3         | σ     | sstarf;              | U+022C6      | ★                  |
| sigmaf;          | U+003C2         | ς     | Star;                | U+022C6      | ★                  |
| sigmav;          | U+003C2         | ς     | star;                | U+02606      | ★                  |
| sim;             | U+0223C         | ~     | starf;               | U+02605      | ★                  |
| simdot;          | U+02A6A         | ~     | straightepsilon;     | U+003F5      | ε                  |
| sime;            | U+02243         | ≈     | straightphi;         | U+003D5      | φ                  |
| simeq;           | U+02243         | ≈     | strns;               | U+000AF      | ‐                  |
| simg;            | U+02A9E         | ≥     | Sub;                 | U+022D0      | ⊑                  |
| simgE;           | U+02AA0         | ≥     | sub;                 | U+02282      | ⊓                  |
| siml;            | U+02A9D         | ≥     | subdot;              | U+02ABD      | ⊓                  |
| simlE;           | U+02A9F         | ≥     | subE;                | U+02AC5      | ⊑                  |
| simne;           | U+02246         | ≯     | sube;                | U+02286      | ⊑                  |
| simplus;         | U+02A24         | +     | subedot;             | U+02AC3      | ⊓                  |
| simrarr;         | U+02972         | ⇒     | submult;             | U+02AC1      | ⊓                  |
| slarr;           | U+02190         | ←     | subnE;               | U+02ACB      | ⊑                  |
| SmallCircle;     | U+02218         | ◦     | subne;               | U+0228A      | ⊑                  |
| smallsetminus;   | U+02216         | \     | subplus;             | U+02ABF      | ⊓                  |
| smashp;          | U+02A33         | ※     | subrarr;             | U+02979      | ⊓                  |
| smeparsl;        | U+029E4         | ≠     | Subset;              | U+022D0      | ⊑                  |
| smid;            | U+02223         |       | subset;              | U+02282      | ⊓                  |
| smile;           | U+02323         | ‿     | subseteq;            | U+02286      | ⊑                  |
| smt;             | U+02AAA         | <     | subseteqq;           | U+02AC5      | ⊑                  |
| smte;            | U+02AAC         | ≤     | SubsetEqual;         | U+02286      | ⊑                  |
| smtes;           | U+02AAC U+0FE00 | ≤     | subsetneq;           | U+0228A      | ⊑                  |
| SOFTcy;          | U+0042C         | Ь     | subsetneqq;          | U+02ACB      | ⊑                  |
| softcy;          | U+0044C         | Ь     | subsim;              | U+02AC7      | ⊓                  |
| sol;             | U+0002F         | /     | subsub;              | U+02AD5      | ⊓                  |
| solb;            | U+029C4         | □     | subsup;              | U+02AD3      | ⊓                  |
| solbar;          | U+0233F         | +     | succ;                | U+0227B      | succ               |
| Sopf;            | U+1D54A         | Ѕ     | succapprox;          | U+02AB8      | succapprox         |
| sopf;            | U+1D564         | Ѕ     | succcurlyeq;         | U+0227D      | succcurlyeq        |
| spades;          | U+02660         | ♠     | Succeeds;            | U+0227B      | succeeds           |
| spadesuit;       | U+02660         | ♠     | SucceedsEqual;       | U+02AB0      | succeedsEqual      |
| spar;            | U+02225         |       | SucceedsSlantEqual;  | U+0227D      | succeedsSlantEqual |
| sqcap;           | U+02293         | □     | SucceedsTilde;       | U+0227F      | succeedsTilde      |
| sqcaps;          | U+02293 U+0FE00 | □     | succeq;              | U+02AB0      | succeq             |
| sqcup;           | U+02294         | □     | succnapprox;         | U+02ABA      | succnapprox        |
| sqcups;          | U+02294 U+0FE00 | □     | succneqq;            | U+02AB6      | succneqq           |
| Sqrt;            | U+0221A         | √     | succnsim;            | U+022E9      | succnsim           |
| sqsub;           | U+0228F         | □     | succsim;             | U+0227F      | succsim            |
| sqsube;          | U+02291         | □     | SuchThat;            | U+0220B      | SuchThat           |
| sqsubset;        | U+0228F         | □     | Sum;                 | U+02211      | Σ                  |
| sqsubseteq;      | U+02291         | □     | sum;                 | U+02211      | Σ                  |
| sqsup;           | U+02290         | □     | sung;                | U+0266A      | ♪                  |
| sqsupe;          | U+02292         | □     | Sup;                 | U+022D1      | ⌚                  |
| sqsupset;        | U+02290         | □     | sup;                 | U+02283      | ⌚                  |
| sqsupseteq;      | U+02292         | □     | sup1;                | U+000B9      | ¹                  |
| squ;             | U+025A1         | □     | sup1                 | U+000B9      | ¹                  |
| Square;          | U+025A1         | □     | sup2;                | U+000B2      | ²                  |

| Name           | Character(s)    | Glyph | Name               | Character(s) | Glyph |
|----------------|-----------------|-------|--------------------|--------------|-------|
| sup2           | U+000B2         | ²     | THORN              | U+000DE      | Þ     |
| sup3;          | U+000B3         | ³     | thorn;             | U+000FE      | þ     |
| sup3           | U+000B3         | ³     | thorn              | U+000FE      | þ     |
| supdot;        | U+02ABE         | ⌚     | Tilde;             | U+0223C      | ⌚     |
| supdsub;       | U+02AD8         | ♾     | tilde;             | U+002DC      | ⌚     |
| supE;          | U+02AC6         | ߳     | TildeEqual;        | U+02243      | ߳     |
| supe;          | U+02287         | ߳     | TildeFullEqual;    | U+02245      | ߳     |
| supedot;       | U+02AC4         | ߳     | TildeTilde;        | U+02248      | ߳     |
| Superset;      | U+02283         | ߳     | times;             | U+000D7      | ×     |
| SupersetEqual; | U+02287         | ߳     | times              | U+000D7      | ×     |
| suphsol;       | U+027C9         | ߳/    | timesb;            | U+022A0      | ߳     |
| suphsub;       | U+02AD7         | ߳c    | timesbar;          | U+02A31      | ߳     |
| suplarr;       | U+0297B         | ߳n    | timesd;            | U+02A30      | ߳     |
| supmult;       | U+02AC2         | ߳x    | tint;              | U+0222D      | ߳     |
| supnE;         | U+02ACC         | ߳ꝫ    | toea;              | U+02928      | ߳     |
| supne;         | U+0228B         | ߳ꝩ    | top;               | U+022A4      | ܂     |
| supplus;       | U+02AC0         | ߳Ꝫ    | topbot;            | U+02336      | ܂     |
| Supset;        | U+022D1         | ߳ꝯ    | topcir;            | U+02AF1      | ܂     |
| supset;        | U+02283         | ߳     | Topf;              | U+1D54B      | ܂     |
| supseteq;      | U+02287         | ߳     | topf;              | U+1D565      | ܂     |
| supseteqq;     | U+02AC6         | ߳     | topfork;           | U+02ADA      | ܂     |
| supsetneq;     | U+0228B         | ߳     | tosa;              | U+02929      | ܂     |
| supsetneqq;    | U+02ACC         | ߳ꝫ    | tprime;            | U+02034      | ܂     |
| supsim;        | U+02AC8         | ߳ꝫ    | TRADE;             | U+02122      | ܂     |
| supsub;        | U+02AD4         | ߳ꝫ    | trade;             | U+02122      | ܂     |
| supsup;        | U+02AD6         | ߳ꝫ    | triangle;          | U+025B5      | ܂     |
| swarhk;        | U+02926         | ߳ꝫ    | triangledown;      | U+025BF      | ܂     |
| swArr;         | U+021D9         | ߳ꝫ    | triangleleft;      | U+025C3      | ܂     |
| swarr;         | U+02199         | ߳ꝫ    | trianglelefteq;    | U+022B4      | ܂     |
| swarrow;       | U+02199         | ߳ꝫ    | triangleq;         | U+0225C      | ܂     |
| swnwar;        | U+0292A         | ߳ꝫ    | triangleright;     | U+025B9      | ܂     |
| szlig;         | U+000DF         | ܂     | trianglerighteq;   | U+022B5      | ܂     |
| szlig          | U+000DF         | ܂     | tridot;            | U+025EC      | ܂     |
| Tab;           | U+00009         | ܂     | trie;              | U+0225C      | ܂     |
| target;        | U+02316         | ܂     | triminus;          | U+02A3A      | ܂     |
| Tau;           | U+003A4         | ܂     | TripleDot;         | U+020DB      | ܂     |
| tau;           | U+003C4         | ܂     | triplus;           | U+02A39      | ܂     |
| tbrk;          | U+023B4         | ܂     | trisb;             | U+029CD      | ܂     |
| Tcaron;        | U+00164         | ܂     | tritime;           | U+02A3B      | ܂     |
| tcaron;        | U+00165         | ܂     | trpezium;          | U+023E2      | ܂     |
| Tcedil;        | U+00162         | ܂     | Tscr;              | U+1D4AF      | ܂     |
| tcedil;        | U+00163         | ܂     | tscr;              | U+1D4C9      | ܂     |
| Tcy;           | U+00422         | ܂     | TScy;              | U+00426      | ܂     |
| tcy;           | U+00442         | ܂     | tscy;              | U+00446      | ܂     |
| tdot;          | U+020DB         | ܂     | TSHcy;             | U+0040B      | ܂     |
| telrec;        | U+02315         | ܂     | tshcy;             | U+0045B      | ܂     |
| Tfr;           | U+1D517         | ܂     | Tstrok;            | U+00166      | ܂     |
| tfr;           | U+1D531         | ܂     | tstrok;            | U+00167      | ܂     |
| there4;        | U+02234         | ܂     | twixt;             | U+0226C      | ܂     |
| Therefore;     | U+02234         | ܂     | twoheadleftarrow;  | U+0219E      | ܂     |
| therefore;     | U+02234         | ܂     | twoheadrightarrow; | U+021A0      | ܂     |
| Theta;         | U+00398         | ܂     | Uacute;            | U+000DA      | ܂     |
| theta;         | U+003B8         | ܂     | Uacute             | U+000DA      | ܂     |
| thetasym;      | U+003D1         | ܂     | uacute;            | U+000FA      | ܂     |
| thetav;        | U+003D1         | ܂     | uacute             | U+000FA      | ܂     |
| thickapprox;   | U+02248         | ܂     | Uarr;              | U+0219F      | ܂     |
| thicksim;      | U+0223C         | ܂     | uArr;              | U+021D1      | ܂     |
| ThickSpace;    | U+0205F U+0200A |       | uarr;              | U+02191      | ܂     |
| thinsp;        | U+02009         |       | Uarrocir;          | U+02949      | ܂     |
| ThinSpace;     | U+02009         |       | Ubrcy;             | U+0040E      | ܂     |
| thkap;         | U+02248         | ܂     | ubrcy;             | U+0045E      | ܂     |
| thksim;        | U+0223C         | ܂     | Ubreve;            | U+0016C      | ܂     |
| THORN;         | U+000DE         | Þ     | ubreve;            | U+0016D      | ܂     |

| Name              | Character(s) | Glyph | Name               | Character(s)    | Glyph |
|-------------------|--------------|-------|--------------------|-----------------|-------|
| Ucirc;            | U+000DB      | Û     | urcrop;            | U+0230E         | ݂     |
| Ucirc             | U+000DB      | Û     | Uring;             | U+0016E         | ܂     |
| ucirc;            | U+000FB      | û     | uring;             | U+0016F         | ܁     |
| ucirc             | U+000FB      | û     | urtri;             | U+025F9         | ܄     |
| Ucy;              | U+00423      | ݙ     | Uscr;              | U+1D4B0         | ܕ     |
| ucy;              | U+00443      | ݙ     | uscr;              | U+1D4CA         | ܔ     |
| udarr;            | U+021C5      | ݪ     | utdot;             | U+022F0         | ܊     |
| Udblac;           | U+00170      | ܀     | Utilde;            | U+00168         | ܂     |
| udblac;           | U+00171      | ܁     | utilde;            | U+00169         | ܁     |
| udhar;            | U+0296E      | ݲ     | utri;              | U+025B5         | ܃     |
| ufisht;           | U+0297E      | ݢ     | utrif;             | U+025B4         | ܃     |
| Ufr;              | U+1D518      | ݣ     | uuarr;             | U+021C8         | ܅     |
| ufr;              | U+1D532      | ݣ     | Uuml;              | U+000DC         | ܂     |
| Ugrave;           | U+000D9      | ܁     | Uuml               | U+000DC         | ܂     |
| Ugrave            | U+000D9      | ܁     | uuml;              | U+000FC         | ܁     |
| ugrave;           | U+000F9      | ܁     | uuml               | U+000FC         | ܁     |
| ugrave            | U+000F9      | ܁     | uwangle;           | U+029A7         | ܇     |
| uHar;             | U+02963      | ܅     | vangrt;            | U+0299C         | ܂     |
| uharl;            | U+021BF      | ܀     | varepsilon;        | U+003F5         | ܂     |
| uharr;            | U+021BE      | ܁     | varkappa;          | U+003F0         | ܂     |
| uhblk;            | U+02580      | ܂     | varnothing;        | U+02205         | ܂     |
| ulcorn;           | U+0231C      | ܂     | varphi;            | U+003D5         | ܂     |
| ulcorner;         | U+0231C      | ܂     | varpi;             | U+003D6         | ܂     |
| ulcrop;           | U+0230F      | ܂     | varpropto;         | U+0221D         | ܂     |
| ultri;            | U+025F8      | ܂     | vArr;              | U+021D5         | ܂     |
| Umacr;            | U+0016A      | ܀     | varr;              | U+02195         | ܂     |
| umacr;            | U+0016B      | ܁     | varrho;            | U+003F1         | ܂     |
| uml;              | U+000A8      | ܂     | varsigma;          | U+003C2         | ܂     |
| uml               | U+000A8      | ܂     | varsubsetneq;      | U+0228A U+0FE00 | ܂     |
| UnderBar;         | U+0005F      | ܂     | varsubsetneqq;     | U+02ACB U+0FE00 | ܂     |
| UnderBrace;       | U+023DF      | ܂     | varsupsetneq;      | U+0228B U+0FE00 | ܂     |
| UnderBracket;     | U+023B5      | ܂     | varsupsetneqq;     | U+02ACC U+0FE00 | ܂     |
| UnderParenthesis; | U+023DD      | ܂     | vartheta;          | U+003D1         | ܂     |
| Union;            | U+022C3      | ܂     | vartriangleleft;   | U+022B2         | ܂     |
| UnionPlus;        | U+0228E      | ܂     | vartriangleright;  | U+022B3         | ܂     |
| Uogon;            | U+00172      | ܂     | Vbar;              | U+02AE8         | ܂     |
| uogon;            | U+00173      | ܂     | vBar;              | U+02AE8         | ܂     |
| Uopf;             | U+1D54C      | ܂     | vBarv;             | U+02AE9         | ܂     |
| uopf;             | U+1D566      | ܂     | Vcy;               | U+00412         | ܂     |
| UpArrow;          | U+02191      | ܂     | vcy;               | U+00432         | ܂     |
| Uparrow;          | U+021D1      | ܂     | VDash;             | U+022AB         | ܂     |
| uparrow;          | U+02191      | ܂     | Vdash;             | U+022A9         | ܂     |
| UpArrowBar;       | U+02912      | ܂     | vdash;             | U+022A8         | ܂     |
| UpArrowDownArrow; | U+021C5      | ܂     | Vdashl;            | U+02AE6         | ܂     |
| UpDownArrow;      | U+02195      | ܂     | Vee;               | U+022C1         | ܂     |
| Updownarrow;      | U+021D5      | ܂     | vee;               | U+02228         | ܂     |
| updownarrow;      | U+02195      | ܂     | veebar;            | U+022BB         | ܂     |
| UpEquilibrium;    | U+0296E      | ܂     | veeq;              | U+0225A         | ܂     |
| upharpoonleft;    | U+021BF      | ܀     | vellip;            | U+022EE         | ܂     |
| upharpoonright;   | U+021BE      | ܁     | Verbar;            | U+02016         | ܂     |
| uplus;            | U+0228E      | ܂     | verbar;            | U+0007C         | ܂     |
| UpperLeftArrow;   | U+02196      | ܂     | Vert;              | U+02016         | ܂     |
| UpperRightArrow;  | U+02197      | ܂     | vert;              | U+0007C         | ܂     |
| Upsi;             | U+003D2      | ܂     | VerticalBar;       | U+02223         | ܂     |
| upsi;             | U+003C5      | ܂     | VerticalLine;      | U+0007C         | ܂     |
| upsih;            | U+003D2      | ܂     | VerticalSeparator; | U+02758         | ܂     |
| Upsilon;          | U+003A5      | ܂     | VerticalTilde;     | U+02240         | ܂     |
| upsilon;          | U+003C5      | ܂     | VeryThinSpace;     | U+0200A         | ܂     |
| UpTee;            | U+022A5      | ܂     | Vfr;               | U+1D519         | ܂     |
| UpTeeArrow;       | U+021A5      | ܂     | vfr;               | U+1D533         | ܂     |
| upuparrows;       | U+021C8      | ܂     | vltri;             | U+022B2         | ܂     |
| urcorn;           | U+0231D      | ܂     | vnsub;             | U+02282 U+020D2 | ܂     |
| urcorner;         | U+0231D      | ܂     |                    |                 |       |

| Name     | Character(s)    | Glyph | Name            | Character(s) | Glyph |
|----------|-----------------|-------|-----------------|--------------|-------|
| vnsup;   | U+02283 U+020D2 | ᩃ     | xuplus;         | U+02A04      | ᩄ     |
| Vopf;    | U+1D54D         | ᩅ     | xutri;          | U+025B3      | ᩆ     |
| vopf;    | U+1D567         | ᩇ     | xvee;           | U+022C1      | ᩈ     |
| vprop;   | U+0221D         | ᩉ     | xwedge;         | U+022C0      | ᩊ     |
| vrtri;   | U+022B3         | ᩌ     | Yacute;         | U+000DD      | ᩍ     |
| Vscr;    | U+1D4B1         | ᩏ     | Yacute          | U+000DD      | ᩍ     |
| vscr;    | U+1D4CB         | ᩏ     | yacute;         | U+000FD      | ᩎ     |
| vsubnE;  | U+02ACB U+0FE00 | ᩐ     | yacute          | U+000FD      | ᩎ     |
| vsubne;  | U+0228A U+0FE00 | ᩐ     | Yacy;           | U+0042F      | ᩏ     |
| vsupnE;  | U+02ACC U+0FE00 | ᩐ     | yacy;           | U+0044F      | ᩏ     |
| vsupne;  | U+0228B U+0FE00 | ᩐ     | Ycirc;          | U+00176      | ᩏ     |
| Vvdash;  | U+022AA         | ᩑ     | ycirc;          | U+00177      | ᩎ     |
| vzigzag; | U+0299A         | ᩒ     | Ycy;            | U+0042B      | ᩏ     |
| Wcirc;   | U+00174         | ᩓ     | ycy;            | U+0044B      | ᩏ     |
| wcirc;   | U+00175         | ᩔ     | yen;            | U+000A5      | ᩕ     |
| wedbar;  | U+02A5F         | ᩕ     | yen             | U+000A5      | ᩕ     |
| Wedge;   | U+022C0         | ᩖ     | Yfr;            | U+1D51C      | ᩗ     |
| wedge;   | U+02227         | ᩖ     | yfr;            | U+1D536      | ᩗ     |
| wedgeq;  | U+02259         | ᩖ     | YIcy;           | U+00407      | ᩗ     |
| weierp;  | U+02118         | ᩘ     | yicy;           | U+00457      | ᩗ     |
| Wfr;     | U+1D51A         | ᩙ     | Yopf;           | U+1D550      | ᩕ     |
| wfr;     | U+1D534         | ᩚ     | yopf;           | U+1D56A      | ᩎ     |
| Wopf;    | U+1D54E         | ᩚ     | Yscr;           | U+1D4B4      | ᩗ     |
| wopf;    | U+1D568         | ᩚ     | yscr;           | U+1D4CE      | ᩗ     |
| wp;      | U+02118         | ᩘ     | YUcy;           | U+0042E      | ᩏ     |
| wr;      | U+02240         | ᩚ     | yucy;           | U+0044E      | ᩏ     |
| wreath;  | U+02240         | ᩚ     | Yuml;           | U+00178      | ᩏ     |
| Wscr;    | U+1D4B2         | ᩚ     | yuml;           | U+000FF      | ᩎ     |
| wscr;    | U+1D4CC         | ᩚ     | yuml            | U+000FF      | ᩎ     |
| xcap;    | U+022C2         | ᩚ     | Zacute;         | U+00179      | ᩏ     |
| xcirc;   | U+025EF         | ᩚ     | zacute;         | U+0017A      | ᩏ     |
| xcup;    | U+022C3         | ᩚ     | Zcaron;         | U+0017D      | ᩏ     |
| xdtri;   | U+025BD         | ᩚ     | zcaron;         | U+0017E      | ᩏ     |
| Xfr;     | U+1D51B         | ᩚ     | Zcy;            | U+00417      | ᩏ     |
| xfr;     | U+1D535         | ᩚ     | zcy;            | U+00437      | ᩏ     |
| xhArr;   | U+027FA         | ᩚ     | Zdot;           | U+0017B      | ᩏ     |
| xharr;   | U+027F7         | ᩚ     | zdot;           | U+0017C      | ᩏ     |
| Xi;      | U+0039E         | ᩚ     | zeetrf;         | U+02128      | ᩏ     |
| xi;      | U+003BE         | ᩚ     | ZeroWidthSpace; | U+0200B      |       |
| xlArr;   | U+027F8         | ᩚ     | Zeta;           | U+00396      | ᩏ     |
| xlarr;   | U+027F5         | ᩚ     | zeta;           | U+003B6      | ᩏ     |
| xmap;    | U+027FC         | ᩚ     | Zfr;            | U+02128      | ᩏ     |
| xnis;    | U+022FB         | ᩚ     | zfr;            | U+1D537      | ᩏ     |
| xodot;   | U+02A00         | ᩚ     | ZHcy;           | U+00416      | ᩏ     |
| Xopf;    | U+1D54F         | ᩚ     | zhcy;           | U+00436      | ᩏ     |
| xopf;    | U+1D569         | ᩚ     | zigrarr;        | U+021DD      | ᩚ     |
| xoplus;  | U+02A01         | ᩚ     | Zopf;           | U+02124      | ᩏ     |
| xotime;  | U+02A02         | ᩚ     | zopf;           | U+1D56B      | ᩏ     |
| xrArr;   | U+027F9         | ᩚ     | Zscr;           | U+1D4B5      | ᩏ     |
| xrarr;   | U+027F6         | ᩚ     | zscr;           | U+1D4CF      | ᩏ     |
| Xscr;    | U+1D4B3         | ᩚ     | zwj;            | U+0200D      |       |
| xscr;    | U+1D4CD         | ᩚ     | zwnj;           | U+0200C      |       |
| xsqcup;  | U+02A06         | ᩚ     |                 |              |       |

This data is also available [as a JSON file](#).

The glyphs displayed above are non-normative. Refer to Unicode for formal definitions of the characters listed above.

The character reference names originate from *XML Entity Definitions for Characters*, though only the above is considered normative. [\[XMLENTITY\]](#)

This list is static and [will not be expanded or changed in the future](#).

## 14 The XML syntax



### [HTML/XHTML](#)

Support in all current engines.

Firefox 2+ Safari 3.1+ Chrome 4+

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Opera 9+ Edge 79+

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Edge (Legacy) 12+ Internet Explorer 9+

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Firefox Android 4+ Safari iOS 2+ Chrome Android 18+ WebView Android 2+ Samsung

Internet 1.0+ Opera Android 10.1+

This section only describes the rules for XML resources. Rules for [text/html](#) resources are discussed in the section above entitled "[The HTML syntax](#)".

### 14.1 Writing documents in the XML syntax

The XML syntax for HTML was formerly referred to as "XHTML", but this specification does not use that term (among other reasons, because no such term is used for the HTML syntaxes of MathML and SVG).

The syntax for XML is defined in *XML* and *Namespaces in XML*. [\[XML\]](#) [\[XMLNS\]](#)

This specification does not define any syntax-level requirements beyond those defined for XML proper.

XML documents may contain a **DOCTYPE** if desired, but this is not required to conform to this specification. This specification does not define a public or system identifier, nor provide a formal DTD.

According to *XML*, XML processors are not guaranteed to process the external DTD subset referenced in the DOCTYPE. This means, for example, that using [entity references](#) for characters in XML documents is unsafe if they are defined in an external file (except for &lt;, &gt;, &amp;, &quot;, and &apos;).

### 14.2 Parsing XML documents

This section describes the relationship between XML and the DOM, with a particular emphasis on how this interacts with HTML.

An *XML parser*, for the purposes of this specification, is a construct that follows the rules given in *XML* to map a string of bytes or characters into a [Document](#) object.

At the time of writing, no such rules actually exist.

An [XML parser](#) is either associated with a [Document](#) object when it is created, or creates one implicitly.

This [Document](#) must then be populated with DOM nodes that represent the tree structure of the input passed to the parser, as defined by *XML*, *Namespaces in XML*, and *DOM*. When creating DOM nodes representing elements, the [create an element for a token](#) algorithm or some equivalent that operates on appropriate XML data structures must be used, to ensure the proper [element interfaces](#) are created and that [custom elements](#) are set up correctly.

DOM mutation events must not fire for the operations that the [XML parser](#) performs on the [Document](#)'s tree, but the user agent must act as if elements and attributes were individually appended and set respectively so as to trigger rules in this specification regarding what happens when an element is inserted into a document or has its attributes set, and *DOM*'s requirements regarding [mutation observers](#) mean that mutation observers are fired (unlike mutation events). [\[XML\]](#) [\[XMLNS\]](#) [\[DOM\]](#) [\[UIEVENTS\]](#)

Between the time an element's start tag is parsed and the time either the element's end tag is parsed or the parser detects a well-formedness error, the user agent must act as if the element was in a [stack of open elements](#).

This is used, e.g. by the [object](#) element to avoid instantiating plugins before the [param](#) element children have been parsed.

This specification provides the following additional information that user agents should use when retrieving an external entity: the public identifiers given in the following list all correspond to [the URL given by this link](#). (This URL is a DTD containing the [entity declarations](#) for the names listed in the [named character references](#) section.) [\[XML\]](#)

- -//W3C//DTD XHTML 1.0 Transitional//EN
- -//W3C//DTD XHTML 1.1//EN
- -//W3C//DTD XHTML 1.0 Strict//EN
- -//W3C//DTD XHTML 1.0 Frameset//EN
- -//W3C//DTD XHTML Basic 1.0//EN
- -//W3C//DTD XHTML 1.1 plus MathML 2.0//EN
- -//W3C//DTD XHTML 1.1 plus MathML 2.0 plus SVG 1.1//EN
- -//W3C//DTD MathML 2.0//EN
- -//WAPFORUM//DTD XHTML Mobile 1.0//EN

Furthermore, user agents should attempt to retrieve the above external entity's content when one of the above public identifiers is used, and should not attempt to retrieve any other external entity's content.

This is not strictly a [violation](#) of *XML*, but it does contradict the spirit of *XML*'s requirements. This is motivated by a desire for user agents to all handle entities in an interoperable fashion without requiring any network access for handling external subsets. [\[XML\]](#)

XML parsers can be invoked with *XML scripting support enabled* or *XML scripting support disabled*. Except where otherwise specified, XML parsers are invoked with [XML scripting support enabled](#).

When an [XML parser](#) with [XML scripting support enabled](#) creates a [script](#) element, it must have its [parser document](#) set and its ["non-blocking"](#) flag must be unset. If the parser was created as part of the [XML fragment parsing algorithm](#), then the element must be marked as ["already started"](#) also. When the element's end tag is subsequently parsed, the user agent must [perform a microtask checkpoint](#), and then [prepare](#) the [script](#) element. If this causes there to be a [pending parsing-blocking script](#), then the user agent must run the following steps:

1. Block this instance of the [XML parser](#), such that the [event loop](#) will not run [tasks](#) that invoke it.
2. [Spin the event loop](#) until the parser's [Document](#) [has no style sheet that is blocking scripts](#) and the [pending parsing-blocking script's "ready to be parser-executed"](#) flag is set.
3. Unblock this instance of the [XML parser](#), such that [tasks](#) that invoke it can again be run.
4. [Execute](#) the [pending parsing-blocking script](#).
5. There is no longer a [pending parsing-blocking script](#).

Since the [document.write\(\)](#) API is not available for [XML documents](#), much of the complexity in the [HTML parser](#) is not needed in the [XML parser](#).

When the [XML parser](#) has [XML scripting support disabled](#), none of this happens.

When an [XML parser](#) would append a node to a [template](#) element, it must instead append it to the [template](#) element's [template contents](#) (a [DocumentFragment](#) node).

This is a [willful violation](#) of XML; unfortunately, XML is not formally extensible in the manner that is needed for [template](#) processing. [\[XML\]](#)

When an [XML parser](#) creates a [Node](#) object, its [node document](#) must be set to the [node document](#) of the node into which the newly created node is to be inserted.

Certain algorithms in this specification *spoon-feed the parser* characters one string at a time. In such cases, the [XML parser](#) must act as it would have if faced with a single string consisting of the concatenation of all those characters.

When an [XML parser](#) reaches the end of its input, it must [stop parsing](#), following the same rules as the [HTML parser](#). An [XML parser](#) can also be [aborted](#), which must again be done in the same way as for an [HTML parser](#).

For the purposes of conformance checkers, if a resource is determined to be in the [XML syntax](#),

then it is an [XML document](#).

## 14.3 Serializing XML fragments

The *XML fragment serialization algorithm* for a [Document](#) or [Element](#) node either returns a fragment of XML that represents that node or throws an exception.

For [Documents](#), the algorithm must return a string in the form of a [document entity](#), if none of the error cases below apply.

For [Elements](#), the algorithm must return a string in the form of an [internal general parsed entity](#), if none of the error cases below apply.

In both cases, the string returned must be XML namespace-well-formed and must be an isomorphic serialization of all of that node's [relevant child nodes](#), in [tree order](#). User agents may adjust prefixes and namespace declarations in the serialization (and indeed might be forced to do so in some cases to obtain namespace-well-formed XML). User agents may use a combination of regular text and character references to represent [Text](#) nodes in the DOM.

A node's *relevant child nodes* are those that apply given the following rules:

For [template](#) elements

The [relevant child nodes](#) are the child nodes of the [template](#) element's [template contents](#), if any.

For all other nodes

The [relevant child nodes](#) are the child nodes of node itself, if any.

For [Elements](#), if any of the elements in the serialization are in no namespace, the default namespace in scope for those elements must be explicitly declared as the empty string. (This doesn't apply in the [Document](#) case.) [\[XML\]](#) [\[XMLNS\]](#)

For the purposes of this section, an internal general parsed entity is considered XML namespace-well-formed if a document consisting of an element with no namespace declarations whose contents are the internal general parsed entity would itself be XML namespace-well-formed.

If any of the following error cases are found in the DOM subtree being serialized, then the algorithm must throw an ["InvalidStateError"](#) [DOMException](#) instead of returning a string:

- A [Document](#) node with no child element nodes.
- A [DocumentType](#) node that has an external subset public identifier that contains characters that are not matched by the XML [PubidChar](#) production. [\[XML\]](#)
- A [DocumentType](#) node that has an external subset system identifier that contains both a U+0022 QUOTATION MARK ("") and a U+0027 APOSTROPHE ('') or that contains characters that are not matched by the XML [Char](#) production. [\[XML\]](#)

- A node with a local name containing a U+003A COLON (:).
- A node with a local name that does not match the XML [Name](#) production. [\[XML\]](#)
- An [Attr](#) node with no namespace whose local name is the lowercase string "xmlns". [\[XMLNS\]](#)
- An [Element](#) node with two or more attributes with the same local name and namespace.
- An [Attr](#) node, [Text](#) node, [Comment](#) node, or [ProcessingInstruction](#) node whose data contains characters that are not matched by the XML [Char](#) production. [\[XML\]](#)
- A [Comment](#) node whose data contains two adjacent U+002D HYPHEN-MINUS characters (-) or ends with such a character.
- A [ProcessingInstruction](#) node whose target name is an [ASCII case-insensitive](#) match for the string "xml".
- A [ProcessingInstruction](#) node whose target name contains a U+003A COLON (:).
- A [ProcessingInstruction](#) node whose data contains the string "?>".

These are the only ways to make a DOM unserialisable. The DOM enforces all the other XML constraints; for example, trying to append two elements to a [Document](#) node will throw a ["HierarchyRequestError" DOMException](#).

## 14.4 Parsing XML fragments

The *XML fragment parsing algorithm* either returns a [Document](#) or throws a "[SyntaxError](#)" [DOMException](#). Given a string *input* and a context element [context](#), the algorithm is as follows:

1. Create a new [XML parser](#).
2. [Feed the parser](#) just created the string corresponding to the start tag of the [context](#) element, declaring all the namespace prefixes that are in scope on that element in the DOM, as well as declaring the default namespace (if any) that is in scope on that element in the DOM.

A namespace prefix is in scope if the DOM `lookupNamespaceURI()` method on the element would return a non-null value for that prefix.

The default namespace is the namespace for which the DOM `isDefaultNamespace()` method on the element would return true.

No `DOCTYPE` is passed to the parser, and therefore no external subset is referenced, and therefore no entities will be recognized.

3. [Feed the parser](#) just created the string *input*.
4. [Feed the parser](#) just created the string corresponding to the end tag of the [context](#) element.
5. If there is an XML well-formedness or XML namespace well-formedness error, then

throw a "[SyntaxError](#)" [DOMException](#).

6. If the [document element](#) of the resulting [Document](#) has any sibling nodes, then throw a "[SyntaxError](#)" [DOMException](#).
7. Return the child nodes of the [document element](#) of the resulting [Document](#), in [tree order](#).

## 15 Rendering

User agents are not required to present HTML documents in any particular way. However, this section provides a set of suggestions for rendering HTML documents that, if followed, are likely to lead to a user experience that closely resembles the experience intended by the documents' authors. So as to avoid confusion regarding the normativity of this section, "must" has not been used. Instead, the term "expected" is used to indicate behavior that will lead to this experience. For the purposes of conformance for user agents designated as [supporting the suggested default rendering](#), the term "expected" in this section has the same conformance implications as "must".

### 15.1 Introduction

The suggestions in this section are generally expressed in CSS terms. User agents are expected to either support CSS, or translate from the CSS rules given in this section to approximations for other presentation mechanisms.

In the absence of style-layer rules to the contrary (e.g. author style sheets), user agents are expected to render an element so that it conveys to the user the meaning that the element [represents](#), as described by this specification.

The suggestions in this section generally assume a visual output medium with a resolution of 96dpi or greater, but HTML is intended to apply to multiple media (it is a *media-independent* language). User agent implementers are encouraged to adapt the suggestions in this section to their target media.

---

An element is *being rendered* if it has any associated CSS layout boxes, SVG layout boxes, or some equivalent in other styling languages.

Just being off-screen does not mean the element is not [being rendered](#). The presence of the [hidden](#) attribute normally means the element is not [being rendered](#), though this might be overridden by the style sheets.

The [fully active](#) state does not affect whether an element is [being rendered](#) or not. Even if a document is not [fully active](#) and not shown at all to the user, elements within it can still qualify as "being rendered".

An element is said to *intersect the viewport* when it is [being rendered](#) and its associated CSS layout box intersects the [viewport](#).

Similar to the [being rendered](#) state, elements in non-[fully active](#) documents can still [intersect the viewport](#). The [viewport](#) is not shared between documents and might not always be shown to the user, so an element in a non-[fully active](#) document can still intersect the [viewport](#) associated with its document.

This specification does not define the precise timing for when the intersection is tested, but it is suggested that the timing match that of the Intersection Observer API.

[\[INTERSECTIONOBSERVER\]](#)

---

User agents that do not honor author-level CSS style sheets are nonetheless expected to act as if they applied the CSS rules given in these sections in a manner consistent with this specification and the relevant CSS and Unicode specifications. [\[CSS\]](#) [\[UNICODE\]](#) [\[BIDI\]](#)

This is especially important for issues relating to the ['display'](#), ['unicode-bidi'](#), and ['direction'](#) properties.

## 15.2 The CSS user agent style sheet and presentational hints

The CSS rules given in these subsections are, except where otherwise specified, expected to be used as part of the user-agent level style sheet defaults for all documents that contain [HTML elements](#).

Some rules are intended for the author-level zero-specificity presentational hints part of the CSS cascade; these are explicitly called out as *presentational hints*.

---

When the text below says that an attribute *attribute* on an element *element maps to the pixel length property* (or properties) *properties*, it means that if *element* has an attribute *attribute* set, and parsing that attribute's value using the [rules for parsing non-negative integers](#) doesn't generate an error, then the user agent is expected to use the parsed value as a pixel length for a [presentational hint](#) for *properties*.

When the text below says that an attribute *attribute* on an element *element maps to the dimension property* (or properties) *properties*, it means that if *element* has an attribute *attribute* set, and parsing that attribute's value using the [rules for parsing dimension values](#) doesn't generate an error, then the user agent is expected to use the parsed dimension as the value for a [presentational hint](#) for *properties*, with the value given as a pixel length if the dimension was a length, and with the value given as a percentage if the dimension was a percentage.

When the text below says that an attribute *attribute* on an element *element maps to the dimension property (ignoring zero)* (or properties) *properties*, it means that if *element* has an attribute *attribute* set, and parsing that attribute's value using the [rules for parsing nonzero dimension values](#) doesn't generate an error, then the user agent is expected to use the parsed dimension as the value for a [presentational hint](#) for *properties*, with the value given as a pixel length if the dimension was a length, and with the value given as a percentage if the dimension

was a percentage.

When the text below says that a pair of attributes  $w$  and  $h$  on an element *map to the aspect-ratio property*, it means that if *element* has both attributes  $w$  and  $h$ , and parsing those attributes' values using the [rules for parsing non-negative integers](#) doesn't generate an error for either, then the user agent is expected to use the parsed integers as a [presentational hint](#) for the '[aspect-ratio](#)' property of the form **auto  $w / h$** .

When the text below says that a pair of attributes  $w$  and  $h$  on an element *map to the aspect-ratio property (using dimension rules)*, it means that if *element* has both attributes  $w$  and  $h$ , and parsing those attributes' values using the [rules for parsing dimension values](#) doesn't generate an error or return a percentage for either, then the user agent is expected to use the parsed dimensions as a [presentational hint](#) for the '[aspect-ratio](#)' property of the form **auto  $w / h$** .

When a user agent is to *align descendants* of a node, the user agent is expected to align only those descendants that have both their '[margin-inline-start](#)' and '[margin-inline-end](#)' properties computing to a value other than 'auto', that are over-constrained and that have one of those two margins with a [used value](#) forced to a greater value, and that do not themselves have an applicable **align** attribute. When multiple elements are to [align](#) a particular descendant, the most deeply nested such element is expected to override the others. Aligned elements are expected to be aligned by having the [used values](#) of their margins on the [line-left](#) and [line-right](#) sides be set accordingly. [\[CSSLOGICAL\]](#) [\[CSSWM\]](#)

## 15.3 Non-replaced elements

### 15.3.1 Hidden elements

```
@namespace url(http://www.w3.org/1999/xhtml);

[hidden], area, base, basefont, datalist, head, link, meta, noembed,
noframes, param, rp, script, style, template, title {
 display: none;
}

embed[hidden] { display: inline; height: 0; width: 0; }

input[type=hidden] { display: none !important; }

@media (scripting) {
 noscript { display: none !important; }
}
```

### 15.3.2 The page

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
html, body { display: block; }
```

For each property in the table below, given a [body](#) element, the first attribute that exists [maps to the pixel length property](#) on the [body](#) element. If none of the attributes for a property are found, or if the value of the attribute that was found cannot be parsed successfully, then a default value of 8px is expected to be used for that property instead.

| Property                        | Source                                                                                                               |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <a href="#">'margin-top'</a>    | The <a href="#">body</a> element's <a href="#">marginheight</a> attribute                                            |
| <a href="#">'margin-right'</a>  | The <a href="#">body</a> element's <a href="#">topmargin</a> attribute                                               |
| <a href="#">'margin-bottom'</a> | The <a href="#">body</a> element's <a href="#">container frame element</a> 's <a href="#">marginheight</a> attribute |
| <a href="#">'margin-left'</a>   | The <a href="#">body</a> element's <a href="#">marginwidth</a> attribute                                             |
| <a href="#">'margin-top'</a>    | The <a href="#">body</a> element's <a href="#">rightmargin</a> attribute                                             |
| <a href="#">'margin-right'</a>  | The <a href="#">body</a> element's <a href="#">container frame element</a> 's <a href="#">marginwidth</a> attribute  |
| <a href="#">'margin-bottom'</a> | The <a href="#">body</a> element's <a href="#">bottommargin</a> attribute                                            |
| <a href="#">'margin-left'</a>   | The <a href="#">body</a> element's <a href="#">marginheight</a> attribute                                            |
| <a href="#">'margin-top'</a>    | The <a href="#">body</a> element's <a href="#">container frame element</a> 's <a href="#">marginwidth</a> attribute  |
| <a href="#">'margin-right'</a>  | The <a href="#">body</a> element's <a href="#">marginheight</a> attribute                                            |
| <a href="#">'margin-bottom'</a> | The <a href="#">body</a> element's <a href="#">leftmargin</a> attribute                                              |
| <a href="#">'margin-left'</a>   | The <a href="#">body</a> element's <a href="#">container frame element</a> 's <a href="#">marginwidth</a> attribute  |

If the [body](#) element's [node document](#)'s [browsing context](#) is a [child browsing context](#), and the [container](#) of that [browsing context](#) is a [frame](#) or [iframe](#) element, then the [container frame element](#) of the [body](#) element is that [frame](#) or [iframe](#) element. Otherwise, there is no [container frame element](#).

The above requirements imply that a page can change the margins of another page (including one from another [origin](#)) using, for example, an [iframe](#). This is potentially a security risk, as it might in some cases allow an attack to contrive a situation in which a page is rendered not as the author intended, possibly for the purposes of phishing or otherwise misleading the user.

---

If a [Document](#)'s [browsing context](#) is a [child browsing context](#), then it is expected to be positioned and sized to fit inside the [content box](#) of the [container](#) of that [browsing context](#). If the [container](#) is not [being rendered](#), the [browsing context](#) is expected to have a [viewport](#) with zero width and zero height.

If a [Document](#)'s [browsing context](#) is a [child browsing context](#), the [container](#) of that [browsing context](#) is a [frame](#) or [iframe](#) element, that element has a [scrolling](#) attribute, and that attribute's value is an [ASCII case-insensitive](#) match for the string "off", "noscroll", or "no", then the user agent is expected to prevent any scrollbars from being shown for the [viewport](#) of the [Document](#)'s [browsing context](#), regardless of the '[overflow](#)' property that applies to that [viewport](#).

---

When a `body` element has a `background` attribute set to a non-empty value, the new value is expected to be parsed relative to the element's `node document`, and if this is successful, the user agent is expected to treat the attribute as a `presentational hint` setting the element's '`background-image`' property to the `resulting URL string`.

When a `body` element has a `bgcolor` attribute set, the new value is expected to be parsed using the `rules for parsing a legacy color value`, and if that does not return an error, the user agent is expected to treat the attribute as a `presentational hint` setting the element's '`background-color`' property to the resulting color.

When a `body` element has a `text` attribute, its value is expected to be parsed using the `rules for parsing a legacy color value`, and if that does not return an error, the user agent is expected to treat the attribute as a `presentational hint` setting the element's '`color`' property to the resulting color.

When a `body` element has a `link` attribute, its value is expected to be parsed using the `rules for parsing a legacy color value`, and if that does not return an error, the user agent is expected to treat the attribute as a `presentational hint` setting the '`color`' property of any element in the `Document` matching the `:link pseudo-class` to the resulting color.

When a `body` element has a `vlink` attribute, its value is expected to be parsed using the `rules for parsing a legacy color value`, and if that does not return an error, the user agent is expected to treat the attribute as a `presentational hint` setting the '`color`' property of any element in the `Document` matching the `:visited pseudo-class` to the resulting color.

When a `body` element has an `alink` attribute, its value is expected to be parsed using the `rules for parsing a legacy color value`, and if that does not return an error, the user agent is expected to treat the attribute as a `presentational hint` setting the '`color`' property of any element in the `Document` matching the `:active pseudo-class` and either the `:link pseudo-class` or the `:visited pseudo-class` to the resulting color.

### 15.3.3 Flow content

```
@namespace url(http://www.w3.org/1999/xhtml);

address, blockquote, center, dialog, div, figure, figcaption, footer, form,
header, hr, legend, listing, main, p, plaintext, pre, xmp {
 display: block;
}

blockquote, figure, listing, p, plaintext, pre, xmp {
 margin-block-start: 1em; margin-block-end: 1em;
}

blockquote, figure { margin-inline-start: 40px; margin-inline-end: 40px; }

address { font-style: italic; }
```

```

listing, plaintext, pre, xmp {
 font-family: monospace; white-space: pre;
}

dialog:not([open]) { display: none; }
dialog {
 position: absolute;
 inset-inline-start: 0; inset-inline-end: 0;
 width: fit-content;
 height: fit-content;
 margin: auto;
 border: solid;
 padding: 1em;
 background: white;
 color: black;
}
dialog::backdrop {
 background: rgba(0,0,0,0.1);
}

slot {
 display: contents;
}

```

The following rules are also expected to apply, as [presentational hints](#):

```

@namespace url(http://www.w3.org/1999/xhtml);

pre[wrap] { white-space: pre-wrap; }

```

In [quirks mode](#), the following rules are also expected to apply:

```

@namespace url(http://www.w3.org/1999/xhtml);

form { margin-block-end: 1em; }

```

---

The [center](#) element, and the [div](#) element when it has an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for either the string "center" or the string "middle", are expected to center text within themselves, as if they had their '[text-align](#)' property set to 'center' in a [presentational hint](#), and to [align descendants](#) to the center.

The [div](#) element, when it has an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for the string "left", is expected to left-align text within itself, as if it had its '[text-align](#)' property set to 'left' in a [presentational hint](#), and to [align descendants](#) to the left.

The [div](#) element, when it has an [align](#) attribute whose value is an [ASCII case-insensitive](#)

match for the string "**right**", is expected to right-align text within itself, as if it had its '[text-align](#)' property set to 'right' in a [presentational hint](#), and to [align descendants](#) to the right.

The **div** element, when it has an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for the string "**justify**", is expected to full-justify text within itself, as if it had its '[text-align](#)' property set to 'justify' in a [presentational hint](#), and to [align descendants](#) to the left.

The **dialog** element, when its [is modal](#) flag is true, is expected to act as if it had a user-agent-level style sheet rule setting the following properties:

- '[position](#)' property to 'fixed'
- '[overflow](#)' property to 'auto'
- '[inset-block-start](#)' property to '0'
- '[inset-block-end](#)' property to '0'
- '[max-width](#)' property to 'calc(100% - 6px - 2em)'
- '[max-height](#)' property to 'calc(100% - 6px - 2em)'

#### 15.3.4 Phrasing content

```
@namespace url(http://www.w3.org/1999/xhtml);

cite, dfn, em, i, var { font-style: italic; }
b, strong { font-weight: bolder; }
code, kbd, samp, tt { font-family: monospace; }
big { font-size: larger; }
small { font-size: smaller; }

sub { vertical-align: sub; }
sup { vertical-align: super; }
sub, sup { line-height: normal; font-size: smaller; }

ruby { display: ruby; }
rt { display: ruby-text; }

:link { color: #0000EE; }
:visited { color: #551A8B; }
:link:active, :visited:active { color: #FF0000; }
:link, :visited { text-decoration: underline; cursor: pointer; }

:focus-visible { outline: auto; }

mark { background: yellow; color: black; } /* this color is just a suggestion
abbr[title], acronym[title] { text-decoration: dotted underline; }
ins, u { text-decoration: underline; }
del, s, strike { text-decoration: line-through; }
```

```
q::before { content: open-quote; }
q::after { content: close-quote; }

br { display-outside: newline; } /* this also has bidi implications */
nobr { white-space: nowrap; }
wbr { display-outside: break-opportunity; } /* this also has bidi implications */
nobr wbr { white-space: normal; }
```

The following rules are also expected to apply, as [presentational hints](#):

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
br[clear=left i] { clear: left; }
br[clear=right i] { clear: right; }
br[clear=all i], br[clear=both i] { clear: both; }
```

For the purposes of the CSS ruby model, runs of children of [ruby](#) elements that are not [rt](#) or [rp](#) elements are expected to be wrapped in anonymous boxes whose '[display](#)' property has the value '[ruby-base](#)'. [\[CSSRUBY\]](#)

When a particular part of a ruby has more than one annotation, the annotations should be distributed on both sides of the base text so as to minimize the stacking of ruby annotations on one side.

When it becomes possible to do so, the preceding requirement will be updated to be expressed in terms of CSS ruby. (Currently, CSS ruby does not handle nested [ruby](#) elements or multiple sequential [rt](#) elements, which is how this semantic is expressed.)

User agents that do not support correct ruby rendering are expected to render parentheses around the text of [rt](#) elements in the absence of [rp](#) elements.

---

User agents are expected to support the '[clear](#)' property on inline elements (in order to render [br](#) elements with [clear](#) attributes) in the manner described in the non-normative note to this effect in CSS.

The initial value for the '[color](#)' property is expected to be black. The initial value for the '[background-color](#)' property is expected to be 'transparent'. The canvas's background is expected to be white.

---

When a [font](#) element has a [color](#) attribute, its value is expected to be parsed using the [rules for parsing a legacy color value](#), and if that does not return an error, the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[color](#)' property to the resulting color.

The [font](#) element is expected to override the color of any text decoration that spans the text of

the element to the [used value](#) of the element's '[color](#)' property.

When a [font](#) element has a **face** attribute, the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[font-family](#)' property to the attribute's value.

When a [font](#) element has a **size** attribute, the user agent is expected to use the following steps, known as the *rules for parsing a legacy font size*, to treat the attribute as a [presentational hint](#) setting the element's '[font-size](#)' property:

1. Let *input* be the attribute's value.
2. Let *position* be a pointer into *input*, initially pointing at the start of the string.
3. [Skip ASCII whitespace](#) within *input* given *position*.
4. If *position* is past the end of *input*, there is no [presentational hint](#). Return.
5. If the character at *position* is a U+002B PLUS SIGN character (+), then let *mode* be *relative-plus*, and advance *position* to the next character. Otherwise, if the character at *position* is a U+002D HYPHEN-MINUS character (-), then let *mode* be *relative-minus*, and advance *position* to the next character. Otherwise, let *mode* be *absolute*.
6. [Collect a sequence of code points](#) that are [ASCII digits](#) from *input* given *position*, and let the resulting sequence be *digits*.
7. If *digits* is the empty string, there is no [presentational hint](#). Return.
8. Interpret *digits* as a base-ten integer. Let *value* be the resulting number.
9. If *mode* is *relative-plus*, then increment *value* by 3. If *mode* is *relative-minus*, then let *value* be the result of subtracting *value* from 3.
10. If *value* is greater than 7, let it be 7.
11. If *value* is less than 1, let it be 1.
12. Set '[font-size](#)' to the keyword corresponding to the value of *value* according to the following table:

*value*'[font-size](#)' keyword

|   |             |
|---|-------------|
| 1 | 'x-small'   |
| 2 | 'small'     |
| 3 | 'medium'    |
| 4 | 'large'     |
| 5 | 'x-large'   |
| 6 | 'xx-large'  |
| 7 | 'xxx-large' |

### 15.3.5 Bidirectional text

```
@namespace url(http://www.w3.org/1999/xhtml);

[dir]:dir(ltr), bdi:dir(ltr), input[type=tel i]:dir(ltr) { direction: ltr; }
[dir]:dir(rtl), bdi:dir(rtl) { direction: rtl; }

address, blockquote, center, div, figure, figcaption, footer, form, header, h
legend, listing, main, p, plaintext, pre, summary, xmp, article, aside, h1, h
h3, h4, h5, h6, hgroup, nav, section, table, caption, colgroup, col, thead,
tbody, tfoot, tr, td, th, dir, dd, dl, dt, menu, ol, ul, li, bdi, output,
[dir=ltr i], [dir=rtl i], [dir=auto i] {
 unicode-bidi: isolate;
}

bdo, bdo[dir] { unicode-bidi: isolate-override; }

input[dir=auto i]:is([type=search i], [type=tel i], [type=url i],
[type=email i]), textarea[dir=auto i], pre[dir=auto i] {
 unicode-bidi: plaintext;
}
/* see prose for input elements whose type attribute is in the Text state */
/* the rules setting the 'content' property on br and wbr elements also has b...
```

When an [input](#) element's [dir](#) attribute is in the [auto](#) state and its [type](#) attribute is in the [Text](#) state, then the user agent is expected to act as if it had a user-agent-level style sheet rule setting the ['unicode-bidi'](#) property to 'plaintext'.

Input fields (i.e. [textarea](#) elements, and [input](#) elements when their [type](#) attribute is in the [Text](#), [Search](#), [Telephone](#), [URL](#), or [Email](#) state) are expected to present an editing user interface with a directionality that matches the element's ['direction'](#) property.

When the document's character encoding is [ISO-8859-8](#), the following rules are additionally expected to apply, following those above: [\[ENCODING\]](#)

```
@namespace url(http://www.w3.org/1999/xhtml);

address, blockquote, center, div, figure, figcaption, footer, form, header, h
legend, listing, main, p, plaintext, pre, summary, xmp, article, aside, h1, h
h3, h4, h5, h6, hgroup, nav, section, table, caption, colgroup, col, thead,
tbody, tfoot, tr, td, th, dir, dd, dl, dt, menu, ol, ul, li, [dir=ltr i],
[dir=rtl i], [dir=auto i], *|* {
 unicode-bidi: bidi-override;
}
input:not([type=submit i]):not([type=reset i]):not([type=button i]),
textarea {
```

```
 unicode-bidi: normal;
}
```

### 15.3.6 Sections and headings

```
@namespace url(http://www.w3.org/1999/xhtml);

article, aside, h1, h2, h3, h4, h5, h6, hgroup, nav, section {
 display: block;
}

h1 { margin-block-start: 0.67em; margin-block-end: 0.67em; font-size: 2.00em;
h2 { margin-block-start: 0.83em; margin-block-end: 0.83em; font-size: 1.50em;
h3 { margin-block-start: 1.00em; margin-block-end: 1.00em; font-size: 1.17em;
h4 { margin-block-start: 1.33em; margin-block-end: 1.33em; font-size: 1.00em;
h5 { margin-block-start: 1.67em; margin-block-end: 1.67em; font-size: 0.83em;
h6 { margin-block-start: 2.33em; margin-block-end: 2.33em; font-size: 0.67em;
```

In the following CSS block, x is shorthand for the following selector: `:is(article, aside, nav, section)`

```
@namespace url(http://www.w3.org/1999/xhtml);

x h1 { margin-block-start: 0.83em; margin-block-end: 0.83em; font-size: 1.50em;
x x h1 { margin-block-start: 1.00em; margin-block-end: 1.00em; font-size: 1.17em;
x x x h1 { margin-block-start: 1.33em; margin-block-end: 1.33em; font-size: 1.00em;
x x x x h1 { margin-block-start: 1.67em; margin-block-end: 1.67em; font-size: 0.83em;
x x x x x h1 { margin-block-start: 2.33em; margin-block-end: 2.33em; font-size: 0.67em;

x hgroup > h1 ~ h2 { margin-block-start: 1.00em; margin-block-end: 1.00em; font-size: 1.50em;
x x hgroup > h1 ~ h2 { margin-block-start: 1.33em; margin-block-end: 1.33em; font-size: 1.17em;
x x x hgroup > h1 ~ h2 { margin-block-start: 1.67em; margin-block-end: 1.67em; font-size: 1.00em;
x x x x hgroup > h1 ~ h2 { margin-block-start: 2.33em; margin-block-end: 2.33em; font-size: 0.67em;

x hgroup > h1 ~ h3 { margin-block-start: 1.33em; margin-block-end: 1.33em; font-size: 1.33em;
x x hgroup > h1 ~ h3 { margin-block-start: 1.67em; margin-block-end: 1.67em; font-size: 1.17em;
x x x hgroup > h1 ~ h3 { margin-block-start: 2.33em; margin-block-end: 2.33em; font-size: 0.83em;

x hgroup > h1 ~ h4 { margin-block-start: 1.67em; margin-block-end: 1.67em; font-size: 1.67em;
x x hgroup > h1 ~ h4 { margin-block-start: 2.33em; margin-block-end: 2.33em; font-size: 1.00em;

x hgroup > h1 ~ h5 { margin-block-start: 2.33em; margin-block-end: 2.33em; font-size: 2.00em;
```

The shorthand is used to keep this block at least mildly readable.

### 15.3.7 Lists

```
@namespace url(http://www.w3.org/1999/xhtml);

dir, dd, dl, dt, menu, ol, ul { display: block; }
li { display: list-item; text-align: match-parent; }

dir, dl, menu, ol, ul { margin-block-start: 1em; margin-block-end: 1em; }

:is(dir, dl, menu, ol, ul) :is(dir, dl, menu, ol, ul) {
 margin-block-start: 0; margin-block-end: 0;
}

dd { margin-inline-start: 40px; }
dir, menu, ol, ul { padding-inline-start: 40px; }

ol, ul, menu { counter-reset: list-item; }
ol { list-style-type: decimal; }

dir, menu, ul {
 list-style-type: disc;
}
:is(dir, menu, ol, ul) :is(dir, menu, ul) {
 list-style-type: circle;
}
:is(dir, menu, ol, ul) :is(dir, menu, ol, ul) :is(dir, menu, ul) {
 list-style-type: square;
}
```

The following rules are also expected to apply, as [presentational hints](#):

```
@namespace url(http://www.w3.org/1999/xhtml);

ol[type="1"], li[type="1"] { list-style-type: decimal; }
ol[type=a s], li[type=a s] { list-style-type: lower-alpha; }
ol[type=A s], li[type=A s] { list-style-type: upper-alpha; }
ol[type=i s], li[type=i s] { list-style-type: lower-roman; }
ol[type=I s], li[type=I s] { list-style-type: upper-roman; }
ul[type=none i], li[type=none i] { list-style-type: none; }
ul[type=disc i], li[type=disc i] { list-style-type: disc; }
ul[type=circle i], li[type=circle i] { list-style-type: circle; }
ul[type=square i], li[type=square i] { list-style-type: square; }
```

When rendering [li](#) elements, non-CSS user agents are expected to use the [ordinal value](#) of the [li](#) element to render the counter in the list item marker.

For CSS user agents, some aspects of rendering [list items](#) are defined by the *CSS Lists*

specification. Additionally, the following attribute mappings are expected to apply: [\[CSSLISTS\]](#)

When an `li` element has a `value` attribute, and parsing that attribute's value using the [rules for parsing integers](#) doesn't generate an error, the user agent is expected to use the parsed value `value` as a [presentational hint](#) for the `'counter-set'` property of the form `list-item value`.

When an `ol` element has a `start` attribute or a `reversed` attribute, or both, the user agent is expected to use the following steps to treat the attributes as a [presentational hint](#) for the `'counter-reset'` property:

1. Let `value` be null.
2. If the element has a `start` attribute, then set `value` to the result of parsing the attribute's value using the [rules for parsing integers](#).
3. If the element has a `reversed` attribute, then:
  1. If `value` is an integer, then increment `value` by 1 and return `reversed(list-item) value`.
  2. Otherwise, return `reversed(list-item)`.
- Either the `start` attribute was absent, or parsing its value resulted in an error.
4. Otherwise:
  1. If `value` is an integer, then decrement `value` by 1 and return `list-item value`.
  2. Otherwise, there is no [presentational hint](#).

#### 15.3.8 Tables

```
@namespace url(http://www.w3.org/1999/xhtml);

table { display: table; }
caption { display: table-caption; }
colgroup, colgroup[hidden] { display: table-column-group; }
col, col[hidden] { display: table-column; }
thead, thead[hidden] { display: table-header-group; }
tbody, tbody[hidden] { display: table-row-group; }
tfoot, tfoot[hidden] { display: table-footer-group; }
tr, tr[hidden] { display: table-row; }
td, th { display: table-cell; }

colgroup[hidden], col[hidden], thead[hidden], tbody[hidden],
tfoot[hidden], tr[hidden] {
```

```

 visibility: collapse;
}

table {
 box-sizing: border-box;
 border-spacing: 2px;
 border-collapse: separate;
 text-indent: initial;
}
td, th { padding: 1px; }
th { font-weight: bold; }

caption { text-align: center; }
thead, tbody, tfoot, table > tr { vertical-align: middle; }
tr, td, th { vertical-align: inherit; }

thead, tbody, tfoot, tr { border-color: inherit; }
table[rules=none i], table[rules=groups i], table[rules=rows i],
table[rules=cols i], table[rules=all i], table[frame=void i],
table[frame=above i], table[frame=below i], table[frame=hsides i],
table[frame=lhs i], table[frame=rhs i], table[frame=vsides i],
table[frame=box i], table[frame=border i],
table[rules=none i] > tr > td, table[rules=none i] > tr > th,
table[rules=groups i] > tr > td, table[rules=groups i] > tr > th,
table[rules=rows i] > tr > td, table[rules=rows i] > tr > th,
table[rules=cols i] > tr > td, table[rules=cols i] > tr > th,
table[rules=all i] > tr > td, table[rules=all i] > tr > th,
table[rules=none i] > thead > tr > td, table[rules=none i] > thead > tr > th,
table[rules=groups i] > thead > tr > td, table[rules=groups i] > thead > tr >
table[rules=rows i] > thead > tr > td, table[rules=rows i] > thead > tr > th,
table[rules=cols i] > thead > tr > td, table[rules=cols i] > thead > tr > th,
table[rules=all i] > thead > tr > td, table[rules=all i] > thead > tr > th,
table[rules=none i] > tbody > tr > td, table[rules=none i] > tbody > tr > th,
table[rules=groups i] > tbody > tr > td, table[rules=groups i] > tbody > tr >
table[rules=rows i] > tbody > tr > td, table[rules=rows i] > tbody > tr > th,
table[rules=cols i] > tbody > tr > td, table[rules=cols i] > tbody > tr > th,
table[rules=all i] > tbody > tr > td, table[rules=all i] > tbody > tr > th,
table[rules=none i] > tfoot > tr > td, table[rules=none i] > tfoot > tr > th,
table[rules=groups i] > tfoot > tr > td, table[rules=groups i] > tfoot > tr >
table[rules=rows i] > tfoot > tr > td, table[rules=rows i] > tfoot > tr > th,
table[rules=cols i] > tfoot > tr > td, table[rules=cols i] > tfoot > tr > th,
table[rules=all i] > tfoot > tr > td, table[rules=all i] > tfoot > tr > th {
 border-color: black;
}

```

The following rules are also expected to apply, as [presentational hints](#):

```
@namespace url(http://www.w3.org/1999/xhtml);

table[align=left i] { float: left; }
table[align=right i] { float: right; }
table[align=center i] { margin-inline-start: auto; margin-inline-end: auto; }
thead[align=absmiddle i], tbody[align=absmiddle i], tfoot[align=absmiddle i],
tr[align=absmiddle i], td[align=absmiddle i], th[align=absmiddle i] {
 text-align: center;
}

caption[align=bottom i] { caption-side: bottom; }
p[align=left i], h1[align=left i], h2[align=left i], h3[align=left i],
h4[align=left i], h5[align=left i], h6[align=left i] {
 text-align: left;
}
p[align=right i], h1[align=right i], h2[align=right i], h3[align=right i],
h4[align=right i], h5[align=right i], h6[align=right i] {
 text-align: right;
}
p[align=center i], h1[align=center i], h2[align=center i], h3[align=center i]
h4[align=center i], h5[align=center i], h6[align=center i] {
 text-align: center;
}
p[align=justify i], h1[align=justify i], h2[align=justify i], h3[align=justify]
h4[align=justify i], h5[align=justify i], h6[align=justify i] {
 text-align: justify;
}
thead[valign=top i], tbody[valign=top i], tfoot[valign=top i],
tr[valign=top i], td[valign=top i], th[valign=top i] {
 vertical-align: top;
}
thead[valign=middle i], tbody[valign=middle i], tfoot[valign=middle i],
tr[valign=middle i], td[valign=middle i], th[valign=middle i] {
 vertical-align: middle;
}
thead[valign=bottom i], tbody[valign=bottom i], tfoot[valign=bottom i],
tr[valign=bottom i], td[valign=bottom i], th[valign=bottom i] {
 vertical-align: bottom;
}
thead[valign=baseline i], tbody[valign=baseline i], tfoot[valign=baseline i],
tr[valign=baseline i], td[valign=baseline i], th[valign=baseline i] {
 vertical-align: baseline;
}
td[nowrap], th[nowrap] { white-space: nowrap; }

table[rules=none i], table[rules=groups i], table[rules=rows i],
```

```
table[rules=cols i], table[rules=all i] {
 border-style: hidden;
 border-collapse: collapse;
}
table[border] { border-style: outset; } /* only if border is not equivalent to zero */
table[frame=void i] { border-style: hidden; }
table[frame=above i] { border-style: outset hidden hidden hidden; }
table[frame=below i] { border-style: hidden hidden outset hidden; }
table[frame=hsides i] { border-style: outset hidden outset hidden; }
table[frame=lhs i] { border-style: hidden hidden hidden outset; }
table[frame=rhs i] { border-style: hidden outset hidden hidden; }
table[frame=vsides i] { border-style: hidden outset; }
table[frame=box i], table[frame=border i] { border-style: outset; }

table[border] > tr > td, table[border] > tr > th,
table[border] > thead > tr > td, table[border] > thead > tr > th,
table[border] > tbody > tr > td, table[border] > tbody > tr > th,
table[border] > tfoot > tr > td, table[border] > tfoot > tr > th {
 /* only if border is not equivalent to zero */
 border-width: 1px;
 border-style: inset;
}
table[rules=none i] > tr > td, table[rules=none i] > tr > th,
table[rules=none i] > thead > tr > td, table[rules=none i] > thead > tr > th,
table[rules=none i] > tbody > tr > td, table[rules=none i] > tbody > tr > th,
table[rules=none i] > tfoot > tr > td, table[rules=none i] > tfoot > tr > th,
table[rules=groups i] > tr > td, table[rules=groups i] > tr > th,
table[rules=groups i] > thead > tr > td, table[rules=groups i] > thead > tr > th,
table[rules=groups i] > tbody > tr > td, table[rules=groups i] > tbody > tr > th,
table[rules=groups i] > tfoot > tr > td, table[rules=groups i] > tfoot > tr > th,
table[rules=rows i] > tr > td, table[rules=rows i] > tr > th,
table[rules=rows i] > thead > tr > td, table[rules=rows i] > thead > tr > th,
table[rules=rows i] > tbody > tr > td, table[rules=rows i] > tbody > tr > th,
table[rules=rows i] > tfoot > tr > td, table[rules=rows i] > tfoot > tr > th
 border-width: 1px;
 border-style: none;
}
table[rules=cols i] > tr > td, table[rules=cols i] > tr > th,
table[rules=cols i] > thead > tr > td, table[rules=cols i] > thead > tr > th,
table[rules=cols i] > tbody > tr > td, table[rules=cols i] > tbody > tr > th,
table[rules=cols i] > tfoot > tr > td, table[rules=cols i] > tfoot > tr > th
 border-width: 1px;
 border-block-start-style: none;
 border-inline-end-style: solid;
 border-block-end-style: none;
 border-inline-start-style: solid;
}
```

```

table[rules=all i] > tr > td, table[rules=all i] > tr > th,
table[rules=all i] > thead > tr > td, table[rules=all i] > thead > tr > th,
table[rules=all i] > tbody > tr > td, table[rules=all i] > tbody > tr > th,
table[rules=all i] > tfoot > tr > td, table[rules=all i] > tfoot > tr > th {
 border-width: 1px;
 border-style: solid;
}

table[rules=groups i] > colgroup {
 border-inline-start-width: 1px;
 border-inline-start-style: solid;
 border-inline-end-width: 1px;
 border-inline-end-style: solid;
}
table[rules=groups i] > thead,
table[rules=groups i] > tbody,
table[rules=groups i] > tfoot {
 border-block-start-width: 1px;
 border-block-start-style: solid;
 border-block-end-width: 1px;
 border-block-end-style: solid;
}
table[rules=rows i] > tr, table[rules=rows i] > thead > tr,
table[rules=rows i] > tbody > tr, table[rules=rows i] > tfoot > tr {
 border-block-start-width: 1px;
 border-block-start-style: solid;
 border-block-end-width: 1px;
 border-block-end-style: solid;
}

```

In [quirks mode](#), the following rules are also expected to apply:

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```

table {
 font-weight: initial;
 font-style: initial;
 font-variant: initial;
 font-size: initial;
 line-height: initial;
 white-space: initial;
 text-align: initial;
}
```

---

For the purposes of the CSS table model, the [col](#) element is expected to be treated as if it was

present as many times as its [span](#) attribute [specifies](#).

For the purposes of the CSS table model, the [colgroup](#) element, if it contains no [col](#) element, is expected to be treated as if it had as many such children as its [span](#) attribute [specifies](#).

For the purposes of the CSS table model, the [colspan](#) and [rowspan](#) attributes on [td](#) and [th](#) elements are expected to [provide](#) the *special knowledge* regarding cells spanning rows and columns.

In [HTML documents](#), the following rules are also expected to apply:

```
@namespace url(http://www.w3.org/1999/xhtml);
:is(table, thead, tbody, tfoot, tr) > form { display: none !important; }
```

---

The [table](#) element's [cellspacing](#) attribute [maps to the pixel length property 'border-spacing'](#) on the element.

The [table](#) element's [cellpadding](#) attribute [maps to the pixel length properties 'padding-top', 'padding-right', 'padding-bottom', and 'padding-left'](#) of any [td](#) and [th](#) elements that have corresponding [cells](#) in the [table](#) corresponding to the [table](#) element.

The [table](#) element's [height](#) attribute [maps to the dimension property \(ignoring zero\) 'height'](#) on the [table](#) element.

The [table](#) element's [width](#) attribute [maps to the dimension property \(ignoring zero\) 'width'](#) on the [table](#) element.

The [col](#) element's [width](#) attribute [maps to the dimension property 'width'](#) on the [col](#) element.

The [thead](#), [tbody](#), and [tfoot](#) elements' [height](#) attribute [maps to the dimension property 'height'](#) on the element.

The [tr](#) element's [height](#) attribute [maps to the dimension property 'height'](#) on the [tr](#) element.

The [td](#) and [th](#) elements' [height](#) attributes [map to the dimension property \(ignoring zero\) 'height'](#) on the element.

The [td](#) and [th](#) elements' [width](#) attributes [map to the dimension property \(ignoring zero\) 'width'](#) on the element.

---

The [thead](#), [tbody](#), [tfoot](#), [tr](#), [td](#), and [th](#) elements, when they have an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for either the string "center" or the string "middle", are expected to center text within themselves, as if they had their ['text-align'](#)

property set to 'center' in a [presentational hint](#), and to [align descendants](#) to the center.

The [thead](#), [tbody](#), [tfoot](#), [tr](#), [td](#), and [th](#) elements, when they have an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for the string "[left](#)", are expected to left-align text within themselves, as if they had their '[text-align](#)' property set to 'left' in a [presentational hint](#), and to [align descendants](#) to the left.

The [thead](#), [tbody](#), [tfoot](#), [tr](#), [td](#), and [th](#) elements, when they have an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for the string "[right](#)", are expected to right-align text within themselves, as if they had their '[text-align](#)' property set to 'right' in a [presentational hint](#), and to [align descendants](#) to the right.

The [thead](#), [tbody](#), [tfoot](#), [tr](#), [td](#), and [th](#) elements, when they have an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for the string "[justify](#)", are expected to full-justify text within themselves, as if they had their '[text-align](#)' property set to 'justify' in a [presentational hint](#), and to [align descendants](#) to the left.

User agents are expected to have a rule in their user agent style sheet that matches [th](#) elements that have a parent node whose [computed value](#) for the '[text-align](#)' property is its initial value, whose declaration block consists of just a single declaration that sets the '[text-align](#)' property to the value 'center'.

---

When a [table](#), [thead](#), [tbody](#), [tfoot](#), [tr](#), [td](#), or [th](#) element has a [background](#) attribute set to a non-empty value, the new value is expected to be [parsed](#) relative to the element's [node document](#), and if this is successful, the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[background-image](#)' property to the [resulting URL string](#).

When a [table](#), [thead](#), [tbody](#), [tfoot](#), [tr](#), [td](#), or [th](#) element has a [bgcolor](#) attribute set, the new value is expected to be parsed using the [rules for parsing a legacy color value](#), and if that does not return an error, the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[background-color](#)' property to the resulting color.

When a [table](#) element has a [bordercolor](#) attribute, its value is expected to be parsed using the [rules for parsing a legacy color value](#), and if that does not return an error, the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[border-top-color](#)', '[border-right-color](#)', '[border-bottom-color](#)', and '[border-left-color](#)' properties to the resulting color.

---

The [table](#) element's [border](#) attribute [maps to the pixel length properties](#) '[border-top-width](#)', '[border-right-width](#)', '[border-bottom-width](#)', '[border-left-width](#)' on the element. If the attribute is present but parsing the attribute's value using the [rules for parsing non-negative integers](#) generates an error, a default value of 1px is expected to be used for that property instead.

Rules marked "*only if border is not equivalent to zero*" in the CSS block above is expected to

only be applied if the `border` attribute mentioned in the selectors for the rule is not only present but, when parsed using the [rules for parsing non-negative integers](#), is also found to have a value other than zero or to generate an error.

---

In [quirks mode](#), a `td` element or a `th` element that has a `nowrap` attribute but also has a `width` attribute whose value, when parsed using the [rules for parsing nonzero dimension values](#), is found to be a length (not an error or a number classified as a percentage), is expected to have a [presentational hint](#) setting the element's '`white-space`' property to 'normal', overriding the rule in the CSS block above that sets it to 'nowrap'.

### 15.3.9 Margin collapsing quirks

A node is *substantial* if it is a text node that is not [inter-element whitespace](#), or if it is an element node.

A node is *blank* if it is an element that contains no [substantial](#) nodes.

The *elements with default margins* are the following elements: [blockquote](#), [dir](#), [dl](#), [h1](#), [h2](#), [h3](#), [h4](#), [h5](#), [h6](#), [listing](#), [menu](#), [ol](#), [p](#), [plaintext](#), [pre](#), [ul](#), [xmp](#)

In [quirks mode](#), any [element with default margins](#) that is the [child](#) of a `body`, `td`, or `th` element and has no [substantial](#) previous siblings is expected to have a user-agent level style sheet rule that sets its '[margin-block-start](#)' property to zero.

In [quirks mode](#), any [element with default margins](#) that is the [child](#) of a `body`, `td`, or `th` element, has no [substantial](#) previous siblings, and is [blank](#), is expected to have a user-agent level style sheet rule that sets its '[margin-block-end](#)' property to zero also.

In [quirks mode](#), any [element with default margins](#) that is the [child](#) of a `td` or `th` element, has no [substantial](#) following siblings, and is [blank](#), is expected to have a user-agent level style sheet rule that sets its '[margin-block-start](#)' property to zero.

In [quirks mode](#), any `p` element that is the [child](#) of a `td` or `th` element and has no [substantial](#) following siblings, is expected to have a user-agent level style sheet rule that sets its '[margin-block-end](#)' property to zero.

### 15.3.10 Form controls

```
@namespace url(http://www.w3.org/1999/xhtml);

input, select, button, textarea {
 letter-spacing: initial;
 word-spacing: initial;
 line-height: initial;
 text-transform: initial;
 text-indent: initial;
```

```

 text-shadow: initial;
}

input, select, textarea {
 text-align: initial;
}

input:is([type=reset i], [type=button i], [type=submit i]), button {
 text-align: center;
}

input, button {
 display: inline-block;
}

input:is([type=radio i], [type=checkbox i], [type=reset i], [type=button i],
[type=submit i], [type=color i], [type=search i]), select, button {
 box-sizing: border-box;
}

textarea { white-space: pre-wrap; }

```

In [quirks mode](#), the following rules are also expected to apply:

```
@namespace url(http://www.w3.org/1999/xhtml);

input:not([type=image i]), textarea { box-sizing: border-box; }
```

Each kind of form control is also described in the [Widgets](#) section, which describes the look and feel of the control.

For [input](#) elements where the [type](#) attribute is not in the [Hidden](#) state or the [Image Button](#) state, and that are [being rendered](#), are expected to act as follows:

- The [inner display type](#) is always 'flow-root'.
- The '[overflow](#)' property is ignored, and always behaves as 'visible' for the purpose of interaction with other CSS features (in particular, the '[vertical-align](#)' property), but still clips any overflow at the border edge, and no scrolling mechanism is displayed.

### 15.3.11 The [hr](#) element

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
hr {
 color: gray;
 border-style: inset;
```

```
border-width: 1px;
margin-block-start: 0.5em;
margin-inline-end: auto;
margin-block-end: 0.5em;
margin-inline-start: auto;
overflow: hidden;
}
```

The following rules are also expected to apply, as [presentational hints](#):

```
@namespace url(http://www.w3.org/1999/xhtml);

hr[align=left i] { margin-left: 0; margin-right: auto; }
hr[align=right i] { margin-left: auto; margin-right: 0; }
hr[align=center i] { margin-left: auto; margin-right: auto; }
hr[color], hr[noshade] { border-style: solid; }
```

If an [hr](#) element has either a [color](#) attribute or a [noshade](#) attribute, and furthermore also has a [size](#) attribute, and parsing that attribute's value using the [rules for parsing non-negative integers](#) doesn't generate an error, then the user agent is expected to use the parsed value divided by two as a pixel length for [presentational hints](#) for the properties '[border-top-width](#)', '[border-right-width](#)', '[border-bottom-width](#)', and '[border-left-width](#)' on the element.

Otherwise, if an [hr](#) element has neither a [color](#) attribute nor a [noshade](#) attribute, but does have a [size](#) attribute, and parsing that attribute's value using the [rules for parsing non-negative integers](#) doesn't generate an error, then: if the parsed value is one, then the user agent is expected to use the attribute as a [presentational hint](#) setting the element's '[border-bottom-width](#)' to 0; otherwise, if the parsed value is greater than one, then the user agent is expected to use the parsed value minus two as a pixel length for [presentational hints](#) for the '[height](#)' property on the element.

The [width](#) attribute on an [hr](#) element [maps to the dimension property 'width'](#) on the element.

When an [hr](#) element has a [color](#) attribute, its value is expected to be parsed using the [rules for parsing a legacy color value](#), and if that does not return an error, the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[color](#)' property to the resulting color.

### 15.3.12 The [fieldset](#) and [legend](#) elements

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
fieldset {
display: block;
margin-inline-start: 2px;
margin-inline-end: 2px;
border: groove 2px ThreeDFace;
```

```

padding-block-start: 0.35em;
padding-inline-end: 0.75em;
padding-block-end: 0.625em;
padding-inline-start: 0.75em;
min-inline-size: min-content;
}

legend {
 padding-inline-start: 2px; padding-inline-end: 2px;
}

legend[align=left i] {
 justify-self: left;
}

legend[align=center i] {
 justify-self: center;
}

legend[align=right i] {
 justify-self: right;
}

```

The [fieldset](#) element, when it generates a [CSS box](#), is expected to act as follows:

- The element is expected to establish a new [block formatting context](#).
- The '[display](#)' property is expected to act as follows:
  - If the computed value of '[display](#)' is a value such that the [outer display type](#) is 'inline', then behave as 'inline-block'.
  - Otherwise, behave as 'flow-root'.

This does not change the computed value.

- If the element's box has a child box that matches the conditions in the list below, then the first such child box is the 'fieldset' element's *rendered legend*:
  - The child is a [legend](#) element.
  - The child's used value of '[float](#)' is 'none'.
  - The child's used value of '[position](#)' is not 'absolute' or 'fixed'.
- If the element has a [rendered legend](#), then the border is expected to not be painted behind the rectangle defined as follows, using the writing mode of the fieldset:
  1. The block-start edge of the rectangle is the smaller of the block-start edge of the [rendered legend](#)'s margin rectangle at its static position (ignoring transforms),

and the block-start outer edge of the [fieldset](#)'s border.

2. The block-end edge of the rectangle is the larger of the block-end edge of the [rendered legend](#)'s margin rectangle at its static position (ignoring transforms), and the block-end outer edge of the [fieldset](#)'s border.
  3. The inline-start edge of the rectangle is the smaller of the inline-start edge of the [rendered legend](#)'s border rectangle at its static position (ignoring transforms), and the inline-start outer edge of the [fieldset](#)'s border.
  4. The inline-end edge of the rectangle is the larger of the inline-end edge of the [rendered legend](#)'s border rectangle at its static position (ignoring transforms), and the inline-end outer edge of the [fieldset](#)'s border.
- The space allocated for the element's border on the block-start side is expected to be the element's '[border-block-start-width](#)' or the [rendered legend](#)'s margin box size in the [fieldset](#)'s block-flow direction, whichever is greater.
  - For the purpose of calculating the used '[block-size](#)', if the computed '[block-size](#)' is not 'auto', the space allocated for the [rendered legend](#)'s margin box that spills out past the border, if any, is expected to be subtracted from the '[block-size](#)'. If the content box's block-size would be negative, then let the content box's block-size be zero instead.
  - If the element has a [rendered legend](#), then that element is expected to be the first child box.
  - The [anonymous fieldset content box](#) is expected to appear after the [rendered legend](#) and is expected to contain the content (including the '::before' and '::after' pseudo-elements) of the [fieldset](#) element except for the [rendered legend](#), if there is one.
  - The used value of the '[padding-top](#)', '[padding-right](#)', '[padding-bottom](#)', and '[padding-left](#)' properties are expected to be zero.
  - For the purpose of calculating the min-content inline size, use the greater of the min-content inline size of the [rendered legend](#) and the min-content inline size of the [anonymous fieldset content box](#).
  - For the purpose of calculating the max-content inline size, use the greater of the max-content inline size of the [rendered legend](#) and the max-content inline size of the [anonymous fieldset content box](#).

A [fieldset](#) element's [rendered legend](#), if any, is expected to act as follows:

- The element is expected to establish a new [formatting context](#) for its contents. The type of this [formatting context](#) is determined by its '[display](#)' value, as usual.
- The '[display](#)' property is expected to behave as if its computed value was blockified.

This does not change the computed value.

- If the computed value of 'inline-size' is 'auto', then the used value is the fit-content inline size.
- The element is expected to be positioned in the inline direction as is normal for blocks (e.g., taking into account margins and the 'justify-self' property).
- The element's box is expected to be constrained in the inline direction by the inline content size of the fieldset as if it had used its computed inline padding.

For example, if the fieldset has a specified padding of 50px, then the rendered legend will be positioned 50px in from the fieldset's border. The padding will further apply to the anonymous fieldset content box instead of the fieldset element itself.

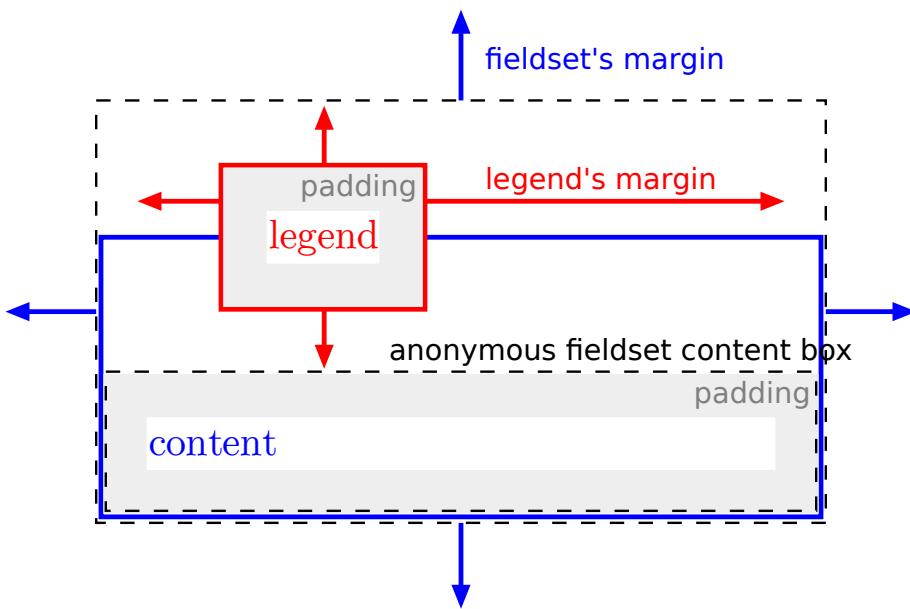
- The element is expected to be positioned in the block-flow direction such that its border box is centered over the border on the block-start side of the fieldset element.

A fieldset element's *anonymous fieldset content box* is expected to act as follows:

- The 'display' property is expected to act as follows:
  - If the computed value of 'display' on the fieldset element is 'grid' or 'inline-grid', then set the used value to 'grid'.
  - If the computed value of 'display' on the fieldset element is 'flex' or 'inline-flex', then set the used value to 'flex'.
  - Otherwise, set the used value to 'flow-root'.
- The following properties are expected to inherit from the fieldset element:
  - 'align-content'
  - 'align-items'
  - 'border-radius'
  - 'column-count'
  - 'column-fill'
  - 'column-gap'
  - 'column-rule'
  - 'column-width'
  - 'flex-direction'
  - 'flex-wrap'
  - 'grid-auto-columns'
  - 'grid-auto-flow'
  - 'grid-auto-rows'
  - 'grid-column-gap'
  - 'grid-row-gap'

- ['grid-template-areas'](#)
- ['grid-template-columns'](#)
- ['grid-template-rows'](#)
- ['justify-content'](#)
- ['justify-items'](#)
- ['overflow'](#)
- ['padding-bottom'](#)
- ['padding-left'](#)
- ['padding-right'](#)
- ['padding-top'](#)
- ['text-overflow'](#)
- ['unicode-bidi'](#)

- The ['block-size'](#) property is expected to be set to '100%'.
- For the purpose of calculating percentage padding, act as if the padding was calculated for the [fieldset](#) element.



The legend is rendered over the top border, and the top border area reserves vertical space for the legend. The fieldset's top margin starts at the top margin edge of the legend. The legend's horizontal margins, or the ['justify-self'](#) property, gives its horizontal position. The [anonymous fieldset content box](#) appears below the legend.

## 15.4 Replaced elements

The following elements can be replaced elements: [audio](#), [canvas](#), [embed](#), [iframe](#), [img](#), [input](#), [object](#), and [video](#).

#### 15.4.1 Embedded content

The `embed`, `iframe`, and `video` elements are expected to be treated as [replaced elements](#).

A `canvas` element that [represents embedded content](#) is expected to be treated as a [replaced element](#); the contents of such elements are the element's bitmap, if any, or else a [transparent black bitmap](#) with the same [intrinsic dimensions](#) as the element. Other `canvas` elements are expected to be treated as ordinary elements in the rendering model.

An `object` element that [represents](#) an image, plugin, or its [nested browsing context](#) is expected to be treated as a [replaced element](#). Other `object` elements are expected to be treated as ordinary elements in the rendering model.

The `audio` element, when it is [exposing a user interface](#), is expected to be treated as a [replaced element](#) about one line high, as wide as is necessary to expose the user agent's user interface features. When an `audio` element is not [exposing a user interface](#), the user agent is expected to force its '`display`' property to compute to 'none', irrespective of CSS rules.

Whether a `video` element is [exposing a user interface](#) is not expected to affect the size of the rendering; controls are expected to be overlaid above the page content without causing any layout changes, and are expected to disappear when the user does not need them.

When a `video` element represents a poster frame or frame of video, the poster frame or frame of video is expected to be rendered at the largest size that maintains the aspect ratio of that poster frame or frame of video without being taller or wider than the `video` element itself, and is expected to be centered in the `video` element.

Any subtitles or captions are expected to be overlayed directly on top of their `video` element, as defined by the relevant rendering rules; for WebVTT, those are the [rules for updating the display of WebVTT text tracks](#). [WEBVTT]

When the user agent starts [exposing a user interface](#) for a `video` element, the user agent should run the [rules for updating the text track rendering](#) of each of the `text tracks` in the `video` element's [list of text tracks](#) that are [showing](#) and whose `text track kind` is one of [subtitles](#) or [captions](#) (e.g., for `text tracks` based on WebVTT, the [rules for updating the display of WebVTT text tracks](#)). [WEBVTT]

Resizing `video` and `canvas` elements does not interrupt video playback or clear the canvas.

---

The following CSS rules are expected to apply:

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
iframe { border: 2px inset; }
video { object-fit: contain; }
```

## 15.4.2 Images

User agents are expected to render `img` elements and `input` elements whose `type` attributes are in the [Image Button](#) state, according to the first applicable rules from the following list:

### If the element [represents](#) an image

The user agent is expected to treat the element as a [replaced element](#) and render the image according to the rules for doing so defined in CSS.

### If the element does not [represent](#) an image and either:

- the user agent has reason to believe that the image will become [available](#) and be rendered in due course, or
- the element has no `alt` attribute, or
- the [Document](#) is in [quirks mode](#), and the element already has [intrinsic dimensions](#) (e.g., from the [dimension attributes](#) or CSS rules)

The user agent is expected to treat the element as a [replaced element](#) whose content is the text that the element represents, if any, optionally alongside an icon indicating that the image is being obtained (if applicable). For `input` elements, the element is expected to appear button-like to indicate that the element is a [button](#).

### If the element is an `img` element that [represents](#) some text and the user agent does not expect this to change

The user agent is expected to treat the element as a non-replaced phrasing element whose content is the text, optionally with an icon indicating that an image is missing, so that the user can request the image be displayed or investigate why it is not rendering. In non-graphical contexts, such an icon should be omitted.

### If the element is an `img` element that [represents](#) nothing and the user agent does not expect this to change

The user agent is expected to treat the element as a [replaced element](#) whose [intrinsic dimensions](#) are 0. (In the absence of further styles, this will cause the element to essentially not be rendered.)

### If the element is an `input` element that does not [represent](#) an image and the user agent does not expect this to change

The user agent is expected to treat the element as a [replaced element](#) consisting of a button whose content is the element's alternative text. The [intrinsic dimensions](#) of the button are expected to be about one line in height and whatever width is necessary to render the text on one line.

The icons mentioned above are expected to be relatively small so as not to disrupt most text but be easily clickable. In a visual environment, for instance, icons could be 16 pixels by 16 pixels square, or 1em by 1em if the images are scalable. In an audio environment, the icon could be a short bleep. The icons are intended to indicate to the user that they can be used to get to whatever options the UA provides for images, and, where appropriate, are expected to provide access to the context menu that would have come up if the user interacted with the actual image.

---

All animated images with the same [absolute URL](#) and the same image data are expected to be rendered synchronized to the same timeline as a group, with the timeline starting at the time of the least recent addition to the group.

In other words, when a second image with the same [absolute URL](#) and animated image data is inserted into a document, it jumps to the point in the animation cycle that is currently being displayed by the first image.

When a user agent is to *restart the animation* for an [img](#) element showing an animated image, all animated images with the same [absolute URL](#) and the same image data in that [img](#) element's [node document](#) are expected to restart their animation from the beginning.

---

The following CSS rules are expected to apply when the [Document](#) is in [quirks mode](#):

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
img[align=left i] { margin-right: 3px; }
img[align=right i] { margin-left: 3px; }
```

#### 15.4.3 Attributes for embedded content and images

The following CSS rules are expected to apply as [presentational hints](#):

```
@namespace url(http://www.w3.org/1999/xhtml);

iframe[frameborder='0'], iframe[frameborder=no i] { border: none; }

embed[align=left i], iframe[align=left i], img[align=left i],
input[type=image i][align=left i], object[align=left i] {
 float: left;
}

embed[align=right i], iframe[align=right i], img[align=right i],
input[type=image i][align=right i], object[align=right i] {
 float: right;
}

embed[align=top i], iframe[align=top i], img[align=top i],
input[type=image i][align=top i], object[align=top i] {
 vertical-align: top;
}

embed[align=baseline i], iframe[align=baseline i], img[align=baseline i],
input[type=image i][align=baseline i], object[align=baseline i] {
 vertical-align: baseline;
```

```

}

embed[align=texttop i], iframe[align=texttop i], img[align=texttop i],
input[type=image i][align=texttop i], object[align=texttop i] {
 vertical-align: text-top;
}

embed[align=absmiddle i], iframe[align=absmiddle i], img[align=absmiddle i],
input[type=image i][align=absmiddle i], object[align=absmiddle i],
embed[align=abscenter i], iframe[align=abscenter i], img[align=abscenter i],
input[type=image i][align=abscenter i], object[align=abscenter i] {
 vertical-align: middle;
}

embed[align=bottom i], iframe[align=bottom i], img[align=bottom i],
input[type=image i][align=bottom i], object[align=bottom i] {
 vertical-align: bottom;
}

```

When an [embed](#), [iframe](#), [img](#), or [object](#) element, or an [input](#) element whose [type](#) attribute is in the [Image Button](#) state, has an [align](#) attribute whose value is an [ASCII case-insensitive](#) match for the string "center" or the string "middle", the user agent is expected to act as if the element's ['vertical-align'](#) property was set to a value that aligns the vertical middle of the element with the parent element's baseline.

The [hspace](#) attribute of [embed](#), [img](#), or [object](#) elements, and [input](#) elements with a [type](#) attribute in the [Image Button](#) state, [maps to the dimension properties 'margin-left'](#) and ['margin-right'](#) on the element.

The [vspace](#) attribute of [embed](#), [img](#), or [object](#) elements, and [input](#) elements with a [type](#) attribute in the [Image Button](#) state, [maps to the dimension properties 'margin-top'](#) and ['margin-bottom'](#) on the element.

When an [img](#) element, [object](#) element, or [input](#) element with a [type](#) attribute in the [Image Button](#) state has a [border](#) attribute whose value, when parsed using the [rules for parsing non-negative integers](#), is found to be a number greater than zero, the user agent is expected to use the parsed value for eight [presentational hints](#): four setting the parsed value as a pixel length for the element's ['border-top-width'](#), ['border-right-width'](#), ['border-bottom-width'](#), and ['border-left-width'](#) properties, and four setting the element's ['border-top-style'](#), ['border-right-style'](#), ['border-bottom-style'](#), and ['border-left-style'](#) properties to the value 'solid'.

The [width](#) and [height](#) attributes on an [img](#) element's [dimension attribute source map to the dimension properties 'width'](#) and ['height'](#) on the [img](#) element respectively. They similarly [map to the aspect-ratio property \(using dimension rules\)](#) of the [img](#) element.

The [width](#) and [height](#) attributes on [embed](#), [iframe](#), [object](#), and [video](#) elements, and [input](#) elements with a [type](#) attribute in the [Image Button](#) state and that either represents an

image or that the user expects will eventually represent an image, [map to the dimension properties 'width' and 'height'](#) on the element respectively.

The [width](#) and [height](#) attributes [map to the aspect-ratio property \(using dimension rules\)](#) on [img](#) and [video](#) elements, and [input](#) elements with a [type](#) attribute in the [Image Button](#) state.

The [width](#) and [height](#) attributes [map to the aspect-ratio property](#) on [canvas](#) elements.

#### 15.4.4 Image maps

Shapes on an [image map](#) are expected to act, for the purpose of the CSS cascade, as elements independent of the original [area](#) element that happen to match the same style rules but inherit from the [img](#) or [object](#) element.

For the purposes of the rendering, only the ['cursor'](#) property is expected to have any effect on the shape.

Thus, for example, if an [area](#) element has a [style](#) attribute that sets the ['cursor'](#) property to 'help', then when the user designates that shape, the cursor would change to a Help cursor.

Similarly, if an [area](#) element had a CSS rule that set its ['cursor'](#) property to 'inherit' (or if no rule setting the ['cursor'](#) property matched the element at all), the shape's cursor would be inherited from the [img](#) or [object](#) element of the [image map](#), not from the parent of the [area](#) element.

### 15.5 Widgets

#### 15.5.1 Introduction

The elements defined in this section can be rendered in a variety of manners, within the guidelines provided below. User agents are encouraged to set the ['appearance'](#) CSS property appropriately to achieve platform-native appearances for widgets, and are expected to implement any relevant animations, etc, that are appropriate for the platform.

#### 15.5.2 Button layout

*Button layout* is as follows:

- If the element is a [button](#) element, then the ['display'](#) property is expected to act as follows:
  - If the computed value of ['display'](#) is 'inline-grid', 'grid', 'inline-flex', or 'flex', then behave as the computed value.
  - Otherwise, if the computed value of ['display'](#) is a value such that the [outer](#)

[display type](#) is 'inline', then behave as 'inline-block'.

- Otherwise, behave as 'flow-root'.
  - The element is expected to establish a new [formatting context](#) for its contents. The type of this formatting context is determined by its ['display'](#) value, as usual.
  - If the element is [absolutely-positioned](#), then for the purpose of the [CSS visual formatting model](#), act as if the element is a [replaced element](#). [\[CSS\]](#)
  - If the [computed value](#) of '[inline-size](#)' is 'auto', then the [used value](#) is the [fit-content inline size](#).
  - For the purpose of the 'normal' keyword of the ['align-self'](#) property, act as if the element is a replaced element.
  - If the element is an [input](#) element, or if it is a [button](#) element and its computed value for ['display'](#) is not 'inline-grid', 'grid', 'inline-flex', or 'flex', then the element's box has a child [anonymous button content box](#) with the following behaviors:
    - The box is a [block-level block container](#) that establishes a new [block formatting context](#) (i.e., ['display'](#) is 'flow-root').
    - If the box does not overflow in the horizontal axis, then it is centered horizontally.
    - If the box does not overflow in the vertical axis, then it is centered vertically.

Otherwise, there is no [anonymous button content box](#).

#### 15.5.3 The [button](#) element

The [button](#) element, when it generates a [CSS box](#), is expected to depict a button and to use button layout whose [anonymous button content box](#)'s contents (if there is an [anonymous button content box](#)) are the child boxes the element's box would otherwise have.

#### 15.5.4 The [details](#) and [summary](#) elements

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
summary {
 display: list-item;
 counter-increment: list-item 0;
 list-style: disclosure-closed inside;
}
details[open] > summary {
 list-style-type: disclosure-open;
```

}

The [details](#) element is expected to render as a [block box](#). The element is also expected to have an internal [shadow tree](#) with two [slots](#). The first [slot](#) is expected to take the [details](#) element's first [summary](#) element child, if any. The second [slot](#) is expected to take the [details](#) element's remaining descendants, if any.

The [details](#) element's first [summary](#) element child, if any, is expected to allow the user to request the details be shown or hidden.

The [details](#) element's second [slot](#) is expected to have its [style](#) attribute set to "`display: block; content-visibility: hidden;`" when the [details](#) element does not have an [open](#) attribute. When it does have the [open](#) attribute, the [style](#) attribute is expected to be removed from the second [slot](#).

Because the slots are hidden inside a shadow tree, this [style](#) attribute is not directly visible to author code. Its impacts, however, are visible. Notably, the choice of `content-visibility: hidden` instead of, e.g., `display: none`, impacts the results of various APIs that query layout information.

#### 15.5.5 The [input](#) element as a text entry widget

An [input](#) element whose [type](#) attribute is in the [Text](#), [Search](#), [Telephone](#), [URL](#), or [Email](#) state, is expected to render as an '[inline-block](#)' box depicting a text control. Additionally, the ['line-height'](#) property, if it has a [computed value](#) equivalent to a value that is less than 1.0, must have a [used value](#) of 1.0.

An [input](#) element whose [type](#) attribute is in the [Password](#) state is expected to render as an '[inline-block](#)' box depicting a text control that obscures data entry.

If these text controls provide a text selection, then, when the user changes the current selection, the user agent is expected to [queue an element task](#) on the [user interaction task source](#) given the [input](#) element to [fire an event](#) named [select](#) at the element, with the [bubbles](#) attribute initialized to true.

If an [input](#) element whose [type](#) attribute is in one of the above states has a [size](#) attribute, and parsing that attribute's value using the [rules for parsing non-negative integers](#) doesn't generate an error, then the user agent is expected to use the attribute as a [presentational hint](#) for the ['width'](#) property on the element, with the value obtained from applying the [converting a character width to pixels](#) algorithm to the value of the attribute.

If an [input](#) element whose [type](#) attribute is in one of the above states does *not* have a [size](#) attribute, then the user agent is expected to act as if it had a user-agent-level style sheet rule setting the ['width'](#) property on the element to the value obtained from applying the [converting a character width to pixels](#) algorithm to the number 20.

The *converting a character width to pixels* algorithm returns  $(\text{size}-1) \times \text{avg} + \text{max}$ , where *size* is

the character width to convert, *avg* is the average character width of the primary font for the element for which the algorithm is being run, in pixels, and *max* is the maximum character width of that same font, also in pixels. (The element's '[letter-spacing](#)' property does not affect the result.)

These text controls are expected to be [scroll containers](#) and support scrolling in the [inline axis](#), but not the [block axis](#).

#### 15.5.6 The [input](#) element as domain-specific widgets

An [input](#) element whose [type](#) attribute is in the [Date](#) state is expected to render as an '[inline-block](#)' box depicting a date control.

An [input](#) element whose [type](#) attribute is in the [Month](#) state is expected to render as an '[inline-block](#)' box depicting a month control.

An [input](#) element whose [type](#) attribute is in the [Week](#) state is expected to render as an '[inline-block](#)' box depicting a week control.

An [input](#) element whose [type](#) attribute is in the [Time](#) state is expected to render as an '[inline-block](#)' box depicting a time control.

An [input](#) element whose [type](#) attribute is in the [Local Date and Time](#) state is expected to render as an '[inline-block](#)' box depicting a local date and time control.

An [input](#) element whose [type](#) attribute is in the [Number](#) state is expected to render as an '[inline-block](#)' box depicting a number control.

These controls are all expected to be about one line high, and about as wide as necessary to show the widest possible value.

#### 15.5.7 The [input](#) element as a range control

An [input](#) element whose [type](#) attribute is in the [Range](#) state is expected to render as an '[inline-block](#)' box depicting a slider control.

When the control is wider than it is tall (or square), the control is expected to be a horizontal slider, with the lowest value on the right if the '[direction](#)' property on this element has a [computed value](#) of 'rtl', and on the left otherwise. When the control is taller than it is wide, it is expected to be a vertical slider, with the lowest value on the bottom.

Predefined suggested values (provided by the [list](#) attribute) are expected to be shown as tick marks on the slider, which the slider can snap to.

User agents are expected to use the [used value](#) of the '[direction](#)' property on the element to determine the direction in which the slider operates. Typically, a left-to-right ('ltr') horizontal control would have the lowest value on the left and the highest value on the right, and vice

versa.

#### 15.5.8 The `input` element as a color well

An `input` element whose `type` attribute is in the `Color` state is expected to depict a color well, which, when activated, provides the user with a color picker (e.g. a color wheel or color palette) from which the color can be changed. The element, when it generates a `CSS box`, is expected to use `button layout`, that has no child boxes of the `anonymous button content box`. The `anonymous button content box` is expected to have a `presentational hint` setting the '`background-color`' property to the element's `value`.

Predefined suggested values (provided by the `list` attribute) are expected to be shown in the color picker interface, not on the color well itself.

#### 15.5.9 The `input` element as a checkbox and radio button widgets

An `input` element whose `type` attribute is in the `Checkbox` state is expected to render as an '`inline-block`' box containing a single checkbox control, with no label.

An `input` element whose `type` attribute is in the `Radio Button` state is expected to render as an '`inline-block`' box containing a single radio button control, with no label.

#### 15.5.10 The `input` element as a file upload control

An `input` element whose `type` attribute is in the `File Upload` state, when it generates a `CSS box`, is expected to render as an '`inline-block`' box containing a span of text giving the filename(s) of the `selected files`, if any, followed by a button that, when activated, provides the user with a file picker from which the selection can be changed. The button is expected to use `button layout` and match the '`::file-selector-button`' pseudo-element. The contents of its `anonymous button content box` are expected to be `implementation-defined` (and possibly locale-specific) text, for example "Choose file".

#### 15.5.11 The `input` element as a button

An `input` element whose `type` attribute is in the `Submit Button`, `Reset Button`, or `Button` state, when it generates a `CSS box`, is expected to depict a button and use `button layout` and the contents of the `anonymous button content box` are expected to be the text of the element's `value` attribute, if any, or text derived from the element's `type` attribute in an `implementation-defined` (and probably locale-specific) fashion, if not.

#### 15.5.12 The `marquee` element

```
@namespace url(http://www.w3.org/1999/xhtml);
```

```
marquee {
```

```
display: inline-block;
text-align: initial;
}
```

The [marquee](#) element, while [turned on](#), is expected to render in an animated fashion according to its attributes as follows:

#### If the element's [behavior](#) attribute is in the [scroll](#) state

Slide the contents of the element in the direction described by the [direction](#) attribute as defined below, such that it begins off the start side of the [marquee](#), and ends flush with the inner end side.

For example, if the [direction](#) attribute is [left](#) (the default), then the contents would start such that their left edge are off the side of the right edge of the [marquee](#)'s [content area](#), and the contents would then slide up to the point where the left edge of the contents are flush with the left inner edge of the [marquee](#)'s [content area](#).

Once the animation has ended, the user agent is expected to [increment the marquee current loop index](#). If the element is still [turned on](#) after this, then the user agent is expected to restart the animation.

#### If the element's [behavior](#) attribute is in the [slide](#) state

Slide the contents of the element in the direction described by the [direction](#) attribute as defined below, such that it begins off the start side of the [marquee](#), and ends off the end side of the [marquee](#).

For example, if the [direction](#) attribute is [left](#) (the default), then the contents would start such that their left edge are off the side of the right edge of the [marquee](#)'s [content area](#), and the contents would then slide up to the point where the *right* edge of the contents are flush with the left inner edge of the [marquee](#)'s [content area](#).

Once the animation has ended, the user agent is expected to [increment the marquee current loop index](#). If the element is still [turned on](#) after this, then the user agent is expected to restart the animation.

#### If the element's [behavior](#) attribute is in the [alternate](#) state

When the [marquee current loop index](#) is even (or zero), slide the contents of the element in the direction described by the [direction](#) attribute as defined below, such that it begins flush with the start side of the [marquee](#), and ends flush with the end side of the [marquee](#).

When the [marquee current loop index](#) is odd, slide the contents of the element in the opposite direction than that described by the [direction](#) attribute as defined below, such that it begins flush with the end side of the [marquee](#), and ends flush with the start side of the [marquee](#).

For example, if the [direction](#) attribute is [left](#) (the default), then the contents would with their right edge flush with the right inner edge of the [marquee](#)'s [content area](#), and the contents would then slide up to the point where the *left* edge of the contents are flush with the left inner edge of the [marquee](#)'s [content area](#).

Once the animation has ended, the user agent is expected to [increment the marquee current loop index](#). If the element is still [turned on](#) after this, then the user agent is expected to continue the animation.

The [direction](#) attribute has the meanings described in the following table:

| <a href="#">direction</a> attribute state | Direction of animation | Start edge | End edge | Opposite direction     |
|-------------------------------------------|------------------------|------------|----------|------------------------|
| <a href="#">left</a>                      | ← Right to left        | Right      | Left     | → Left to Right        |
| <a href="#">right</a>                     | → Left to Right        | Left       | Right    | ← Right to left        |
| <a href="#">up</a>                        | ↑ Up (Bottom to Top)   | Bottom     | Top      | ↓ Down (Top to Bottom) |
| <a href="#">down</a>                      | ↓ Down (Top to Bottom) | Top        | Bottom   | ↑ Up (Bottom to Top)   |

In any case, the animation should proceed such that there is a delay given by the [marquee scroll interval](#) between each frame, and such that the content moves at most the distance given by the [marquee scroll distance](#) with each frame.

When a [marquee](#) element has a [bgcolor](#) attribute set, the value is expected to be parsed using the [rules for parsing a legacy color value](#), and if that does not return an error, the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[background-color](#)' property to the resulting color.

The [width](#) and [height](#) attributes on a [marquee](#) element [map to the dimension properties 'width' and 'height'](#) on the element respectively.

The [intrinsic height](#) of a [marquee](#) element with its [direction](#) attribute in the [up](#) or [down](#) states is 200 [CSS pixels](#).

The [vspace](#) attribute of a [marquee](#) element [maps to the dimension properties 'margin-top' and 'margin-bottom'](#) on the element. The [hspace](#) attribute of a [marquee](#) element [maps to the dimension properties 'margin-left' and 'margin-right'](#) on the element.

The '[overflow](#)' property on the [marquee](#) element is expected to be ignored; overflow is expected to always be hidden.

### 15.5.13 The [meter](#) element

The [meter](#) element is expected to render as an '[inline-block](#)' box with a '[height](#)' of '1em' and a '[width](#)' of '5em', a '[vertical-align](#)' of '-0.2em', and with its contents depicting a gauge.

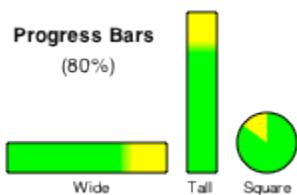
When the element is wider than it is tall (or square), the depiction is expected to be of a horizontal gauge, with the minimum value on the right if the '[direction](#)' property on this element has a [computed value](#) of 'rtl', and on the left otherwise. When the element is taller than it is wide, it is expected to depict a vertical gauge, with the minimum value on the bottom.

User agents are expected to use a presentation consistent with platform conventions for gauges, if any.

Requirements for what must be depicted in the gauge are included in the definition of the [meter](#) element.

#### 15.5.14 The [progress](#) element

The [progress](#) element is expected to render as an '[inline-block](#)' box with a '[height](#)' of '1em' and a '[width](#)' of '10em', and a '[vertical-align](#)' of '-0.2em'.



When the element is wider than it is tall, the element is expected to be depicted as a horizontal progress bar, with the start on the right and the end on the left if the '[direction](#)' property on this element has a [computed value](#) of 'rtl', and with the start on the left and the end on the right otherwise. When the element is taller than it is wide, it is expected to be depicted as a vertical progress bar, with the lowest value on the bottom. When the element is square, it is expected to be depicted as a direction-independent progress widget (e.g. a circular progress ring).

User agents are expected to use a presentation consistent with platform conventions for progress bars. In particular, user agents are expected to use different presentations for determinate and indeterminate progress bars. User agents are also expected to vary the presentation based on the dimensions of the element.

For example, on some platforms for showing indeterminate progress there is a "spinner" progress indicator with square dimensions, which could be used when the element is square, and an indeterminate progress bar, which could be used when the element is wide.

Requirements for how to determine if the progress bar is determinate or indeterminate, and what progress a determinate progress bar is to show, are included in the definition of the [progress](#) element.

#### 15.5.15 The [select](#) element

A [select](#) element is either a *list box* or a *drop-down box*, depending on its attributes.

A [select](#) element whose [multiple](#) attribute is present is expected to render as a multi-select

[list box](#).

A [select](#) element whose [multiple](#) attribute is absent, and whose [display size](#) is greater than 1, is expected to render as a single-select [list box](#).

When the element renders as a [list box](#), it is expected to render as an '[inline-block](#)' box whose [height](#) is the height necessary to contain as many rows for items as given by the element's [display size](#), or four rows if the attribute is absent, and whose [width](#) is the [width of the select's labels](#) plus the width of a scrollbar.

A [select](#) element whose [multiple](#) attribute is absent, and whose [display size](#) is 1, is expected to render as an '[inline-block](#)' one-line [drop-down box](#) whose width is the [width of the select's labels](#).

In either case ([list box](#) or [drop-down box](#)), the element's items are expected to be the element's [list of options](#), with the element's [optgroup](#) element [children](#) providing headers for groups of options where applicable.

An [optgroup](#) element is expected to be rendered by displaying the element's [label](#) attribute.

An [option](#) element is expected to be rendered by displaying the element's [label](#), indented under its [optgroup](#) element if it has one.

The *width of the select's labels* is the wider of the width necessary to render the widest [optgroup](#), and the width necessary to render the widest [option](#) element in the element's [list of options](#) (including its indent, if any).

If a [select](#) element contains a [placeholder label option](#), the user agent is expected to render that [option](#) in a manner that conveys that it is a label, rather than a valid option of the control. This can include preventing the [placeholder label option](#) from being explicitly selected by the user. When the [placeholder label option's selectedness](#) is true, the control is expected to be displayed in a fashion that indicates that no valid option is currently selected.

User agents are expected to render the labels in a [select](#) in such a manner that any alignment remains consistent whether the label is being displayed as part of the page or in a menu control.

#### 15.5.16 The [textarea](#) element

The [textarea](#) element is expected to render as an '[inline-block](#)' box depicting a multiline text control. If this multiline text control provides a selection, then, when the user changes the current selection, the user agent is expected to [queue an element task](#) on the [user interaction task source](#) given the [textarea](#) element to [fire an event](#) named [select](#) at the element, with the [bubbles](#) attribute initialized to true.

If the element has a [cols](#) attribute, and parsing that attribute's value using the [rules for parsing non-negative integers](#) doesn't generate an error, then the user agent is expected to use the attribute as a [presentational hint](#) for the '[width](#)' property on the element, with the value

being the [textarea effective width](#) (as defined below). Otherwise, the user agent is expected to act as if it had a user-agent-level style sheet rule setting the '[width](#)' property on the element to the [textarea effective width](#).

The *textarea effective width* of a [textarea](#) element is  $size \times avg + sbw$ , where *size* is the element's [character width](#), *avg* is the average character width of the primary font of the element, in [CSS pixels](#), and *sbw* is the width of a scrollbar, in [CSS pixels](#). (The element's '[letter-spacing](#)' property does not affect the result.)

If the element has a [rows](#) attribute, and parsing that attribute's value using the [rules for parsing non-negative integers](#) doesn't generate an error, then the user agent is expected to use the attribute as a [presentational hint](#) for the '[height](#)' property on the element, with the value being the [textarea effective height](#) (as defined below). Otherwise, the user agent is expected to act as if it had a user-agent-level style sheet rule setting the '[height](#)' property on the element to the [textarea effective height](#).

The *textarea effective height* of a [textarea](#) element is the height in [CSS pixels](#) of the number of lines specified the element's [character height](#), plus the height of a scrollbar in [CSS pixels](#).

User agents are expected to apply the '[white-space](#)' CSS property to [textarea](#) elements. For historical reasons, if the element has a [wrap](#) attribute whose value is an [ASCII case-insensitive](#) match for the string "[off](#)", then the user agent is expected to treat the attribute as a [presentational hint](#) setting the element's '[white-space](#)' property to 'pre'.

## 15.6 Frames and framesets

User agent are expected to render [frameset](#) elements as a box with the height and width of the [viewport](#), with a surface rendered according to the following layout algorithm:

1. The *cols* and *rows* variables are lists of zero or more pairs consisting of a number and a unit, the unit being one of *percentage*, *relative*, and *absolute*.

Use the [rules for parsing a list of dimensions](#) to parse the value of the element's *cols* attribute, if there is one. Let *cols* be the result, or an empty list if there is no such attribute.

Use the [rules for parsing a list of dimensions](#) to parse the value of the element's *rows* attribute, if there is one. Let *rows* be the result, or an empty list if there is no such attribute.

2. For any of the entries in *cols* or *rows* that have the number zero and the unit *relative*, change the entry's number to one.
3. If *cols* has no entries, then add a single entry consisting of the value 1 and the unit *relative* to *cols*.

If *rows* has no entries, then add a single entry consisting of the value 1 and the unit

*relative to rows.*

4. Invoke the algorithm defined below to [convert a list of dimensions to a list of pixel values](#) using *cols* as the input list, and the width of the surface that the [frameset](#) is being rendered into, in [CSS pixels](#), as the input dimension. Let *sized cols* be the resulting list.

Invoke the algorithm defined below to [convert a list of dimensions to a list of pixel values](#) using *rows* as the input list, and the height of the surface that the [frameset](#) is being rendered into, in [CSS pixels](#), as the input dimension. Let *sized rows* be the resulting list.

5. Split the surface into a grid of  $w \times h$  rectangles, where *w* is the number of entries in *sized cols* and *h* is the number of entries in *sized rows*.

Size the columns so that each column in the grid is as many [CSS pixels](#) wide as the corresponding entry in the *sized cols* list.

Size the rows so that each row in the grid is as many [CSS pixels](#) high as the corresponding entry in the *sized rows* list.

6. Let *children* be the list of [frame](#) and [frameset](#) elements that are [children](#) of the [frameset](#) element for which the algorithm was invoked.
7. For each row of the grid of rectangles created in the previous step, from top to bottom, run these substeps:
  1. For each rectangle in the row, from left to right, run these substeps:
    1. If there are any elements left in *children*, take the first element in the list, and assign it to the rectangle.

If this is a [frameset](#) element, then recurse the entire [frameset](#) layout algorithm for that [frameset](#) element, with the rectangle as the surface.

Otherwise, it is a [frame](#) element; render its [nested browsing context](#), positioned and sized to fit the rectangle.
    2. If there are any elements left in *children*, remove the first element from *children*.
  8. If the [frameset](#) element [has a border](#), draw an outer set of borders around the rectangles, using the element's [frame border color](#).

For each rectangle, if there is an element assigned to that rectangle, and that element [has a border](#), draw an inner set of borders around that rectangle, using the element's [frame border color](#).

For each (visible) border that does not abut a rectangle that is assigned a [frame](#) element with a `noresize` attribute (including rectangles in further nested [frameset](#) elements), the user agent is expected to allow the user to move the border, resizing the rectangles within, keeping the proportions of any nested [frameset](#) grids.

A [frameset](#) or [frame](#) element *has a border* if the following algorithm returns true:

1. If the element has a `frameborder` attribute whose value is not the empty string and whose first character is either a U+0031 DIGIT ONE (1) character, a U+0079 LATIN SMALL LETTER Y character (y), or a U+0059 LATIN CAPITAL LETTER Y character (Y), then return true.
2. Otherwise, if the element has a `frameborder` attribute, return false.
3. Otherwise, if the element has a parent element that is a [frameset](#) element, then return true if *that element has a border*, and false if it does not.
4. Otherwise, return true.

The *frame border color* of a [frameset](#) or [frame](#) element is the color obtained from the following algorithm:

1. If the element has a `bordercolor` attribute, and applying the [rules for parsing a legacy color value](#) to that attribute's value does not result in an error, then return the color so obtained.
2. Otherwise, if the element has a parent element that is a [frameset](#) element, then return the [frame border color](#) of that element.
3. Otherwise, return gray.

The algorithm to *convert a list of dimensions to a list of pixel values* consists of the following steps:

1. Let *input list* be the list of numbers and units passed to the algorithm.

Let *output list* be a list of numbers the same length as *input list*, all zero.

Entries in *output list* correspond to the entries in *input list* that have the same position.

2. Let *input dimension* be the size passed to the algorithm.

3. Let *count percentage* be the number of entries in *input list* whose unit is *percentage*.

Let *total percentage* be the sum of all the numbers in *input list* whose unit is *percentage*.

Let *count relative* be the number of entries in *input list* whose unit is *relative*.

Let *total relative* be the sum of all the numbers in *input list* whose unit is *relative*.

Let *count absolute* be the number of entries in *input list* whose unit is *absolute*.

Let *total absolute* be the sum of all the numbers in *input list* whose unit is *absolute*.

Let *remaining space* be the value of *input dimension*.

4. If *total absolute* is greater than *remaining space*, then for each entry in *input list* whose unit is *absolute*, set the corresponding value in *output list* to the number of the entry in *input list* multiplied by *remaining space* and divided by *total absolute*. Then, set *remaining space* to zero.

Otherwise, for each entry in *input list* whose unit is *absolute*, set the corresponding value in *output list* to the number of the entry in *input list*. Then, decrement *remaining space* by *total absolute*.

5. If *total percentage* multiplied by the *input dimension* and divided by 100 is greater than *remaining space*, then for each entry in *input list* whose unit is *percentage*, set the corresponding value in *output list* to the number of the entry in *input list* multiplied by *remaining space* and divided by *total percentage*. Then, set *remaining space* to zero.

Otherwise, for each entry in *input list* whose unit is *percentage*, set the corresponding value in *output list* to the number of the entry in *input list* multiplied by the *input dimension* and divided by 100. Then, decrement *remaining space* by *total percentage* multiplied by the *input dimension* and divided by 100.

6. For each entry in *input list* whose unit is *relative*, set the corresponding value in *output list* to the number of the entry in *input list* multiplied by *remaining space* and divided by *total relative*.

7. Return *output list*.

User agents working with integer values for frame widths (as opposed to user agents that can lay frames out with subpixel accuracy) are expected to distribute the remainder first to the last entry whose unit is *relative*, then equally (not proportionally) to each entry whose unit is *percentage*, then equally (not proportionally) to each entry whose unit is *absolute*, and finally, failing all else, to the last entry.

---

The contents of a [frame](#) element that does not have a [frameset](#) parent are expected to be rendered as [transparent black](#); the user agent is expected to not render its [nested browsing context](#) in this case, and its [nested browsing context](#) is expected to have a [viewport](#) with zero width and zero height.

## 15.7 Interactive media

### 15.7.1 Links, forms, and navigation

User agents are expected to allow the user to control aspects of [hyperlink](#) activation and [form submission](#), such as which [browsing context](#) is to be used for the subsequent [navigation](#).

User agents are expected to allow users to discover the destination of [hyperlinks](#) and of [forms](#) before triggering their [navigation](#).

User agents are expected to inform the user of whether a [hyperlink](#) includes [hyperlink auditing](#), and to let them know at a minimum which domains will be contacted as part of such auditing.

User agents may allow users to [navigate browsing contexts](#) to the URLs [indicated](#) by the [cite](#) attributes on [q](#), [blockquote](#), [ins](#), and [del](#) elements.

User agents may surface [hyperlinks](#) created by [link](#) elements in their user interface, as discussed [previously](#).

### 15.7.2 The [title](#) attribute

User agents are expected to expose the [advisory information](#) of elements upon user request, and to make the user aware of the presence of such information.

On interactive graphical systems where the user can use a pointing device, this could take the form of a tooltip. When the user is unable to use a pointing device, then the user agent is expected to make the content available in some other fashion, e.g. by making the element a [focusable area](#) and always displaying the [advisory information](#) of the currently [focused](#) element, or by showing the [advisory information](#) of the elements under the user's finger on a touch device as the user pans around the screen.

U+000A LINE FEED (LF) characters are expected to cause line breaks in the tooltip; U+0009 CHARACTER TABULATION (tab) characters are expected to render as a nonzero horizontal shift that lines up the next glyph with the next tab stop, with tab stops occurring at points that are multiples of 8 times the width of a U+0020 SPACE character.

For example, a visual user agent could make elements with a [title](#) attribute [focusable](#), and could make any [focused](#) element with a [title](#) attribute show its tooltip under the element while the element has focus. This would allow a user to tab around the document to find all the advisory text.

As another example, a screen reader could provide an audio cue when reading an element with a tooltip, with an associated key to read the last tooltip for which a cue was played.

### 15.7.3 Editing hosts

The current text editing caret (i.e. the [active range](#), if it is empty and in an [editing host](#)), if any, is expected to act like an inline [replaced element](#) with the vertical dimensions of the caret and with zero width for the purposes of the CSS rendering model.

This means that even an empty block can have the caret inside it, and that when the caret is in such an element, it prevents [margins from collapsing](#) through the element.

### 15.7.4 Text rendered in native user interfaces

User agents are expected to honor the Unicode semantics of text that is exposed in user interfaces, for example supporting the bidirectional algorithm in text shown in dialogs, title bars, popup menus, and tooltips. Text from the contents of elements is expected to be rendered in a manner that honors [the directionality](#) of the element from which the text was obtained. Text from attributes is expected to be rendered in a manner that honours the [directionality of the attribute](#).

Consider the following markup, which has Hebrew text asking for a programming language, the languages being text for which a left-to-right direction is important given the punctuation in some of their names:

```
<p dir="rtl" lang="he">
 <label>
 :????? ??? ???
 > <select>
 <option dir="ltr">C++</option>
 <option dir="ltr">C#</option>
 <option dir="ltr">FreePascal</option>
 <option dir="ltr">F#</option>
 </select>
 </label>
</p>
```

If the [select](#) element was rendered as a drop down box, a correct rendering would ensure that the punctuation was the same both in the drop down, and in the box showing the current selection.



The directionality of attributes depends on the attribute and on the element's [dir](#) attribute, as the following example demonstrates. Consider this markup:

```
<table>
 <tr>
 <th abbr="(?>" dir=ltr>A
 <th abbr="(?>" dir=rtl>A
 <th abbr="(?>" dir=auto>A
 </table>
```

If the [abbr](#) attributes are rendered, e.g. in a tooltip or other user interface, the first will have a left parenthesis (because the direction is 'ltr'), the second will have a right parenthesis (because the direction is 'rtl'), and the third will have a right parenthesis (because the direction is determined *from the attribute value* to be 'rtl').

However, if instead the attribute was not a [directionality-capable attribute](#), the results would be different:

```
<table>
 <tr>
 <th data-abbr="(?>" dir=ltr>A
 <th data-abbr="(?>" dir=rtl>A
 <th data-abbr="(?>" dir=auto>A
 </table>
```

In this case, if the user agent were to expose the [data-abbr](#) attribute in the user interface (e.g. in a debugging environment), the last case would be rendered with a *left* parenthesis, because the direction would be determined from the element's contents.

A string provided by a script (e.g. the argument to [window.alert\(\)](#)) is expected to be treated as an independent set of one or more bidirectional algorithm paragraphs when displayed, as defined by the bidirectional algorithm, including, for instance, supporting the paragraph-breaking behavior of U+000A LINE FEED (LF) characters. For the purposes of determining the paragraph level of such text in the bidirectional algorithm, this specification does *not* provide a higher-level override of rules P2 and P3. [\[BIDI\]](#)

When necessary, authors can enforce a particular direction for a given paragraph by starting it with the Unicode U+200E LEFT-TO-RIGHT MARK or U+200F RIGHT-TO-LEFT MARK characters.

Thus, the following script:

```
alert('!\u05DC\u05DE\u05D3 HTML \u05D4\u05D9\u05D5\u05DD!')
```

...would always result in a message reading "!!!! HTML ????" (not "??? HTML ???!" ), regardless of the language of the user agent interface or the direction of the page or any of its elements.

For a more complex example, consider the following script:

```
/* Warning: this script does not handle right-to-left scripts correctly */
var s;
```

```
if (s = prompt('What is your name?')) {
 alert(s + '! Ok, Fred, ' + s + ', and Wilma will get the car.');
```

When the user enters "Kitty", the user agent would alert "Kitty! Ok, Fred, Kitty, and Wilma will get the car.". However, if the user enters "ع فهم", then the bidirectional algorithm will determine that the direction of the paragraph is right-to-left, and so the output will be the following unintended mess:

```
".and Wilma will get the car ,فهم أ ع ,Ok, Fred ! فهم أ ع"
```

To force an alert that starts with user-provided text (or other text of unknown directionality) to render left-to-right, the string can be prefixed with a U+200E LEFT-TO-RIGHT MARK character:

```
var s;
if (s = prompt('What is your name?')) {
 alert('\u200E' + s + '! Ok, Fred, ' + s + ', and Wilma will get the car.');
```

## 15.8 Print media

User agents are expected to allow the user to request the opportunity to *obtain a physical form* (or a representation of a physical form) of a [Document](#). For example, selecting the option to print a page or convert it to PDF format. [\[PDF\]](#)

When the user actually [obtains a physical form](#) (or a representation of a physical form) of a [Document](#), the user agent is expected to create a new rendering of the [Document](#) for the print media.

## 15.9 Unstyled XML documents

HTML user agents may, in certain circumstances, find themselves rendering non-HTML documents that use vocabularies for which they lack any built-in knowledge. This section provides for a way for user agents to handle such documents in a somewhat useful manner.

While a [Document](#) is an [unstyled document](#), the user agent is expected to render [an unstyled document view](#).

A [Document](#) is an *unstyled document* while it matches the following conditions:

- The [Document](#) has no author style sheets (whether referenced by HTTP headers, processing instructions, elements like [link](#), inline elements like [style](#), or any other mechanism).
- None of the elements in the [Document](#) have any [presentational hints](#).
- None of the elements in the [Document](#) have any [style attributes](#).
- None of the elements in the [Document](#) are in any of the following namespaces: [HTML namespace](#), [SVG namespace](#), [MathML namespace](#)

- The [Document](#) has no [focusable area](#) (e.g. from XLink) other than the [viewport](#).
- The [Document](#) has no [hyperlinks](#) (e.g. from XLink).
- There exists no [script](#) whose [settings object](#) specifies this [Document](#) as the [responsible document](#).
- None of the elements in the [Document](#) have any registered event listeners.

An *unstyled document view* is one where the DOM is not rendered according to CSS (which would, since there are no applicable styles in this context, just result in a wall of text), but is instead rendered in a manner that is useful for a developer. This could consist of just showing the [Document](#) object's source, maybe with syntax highlighting, or it could consist of displaying just the DOM tree, or simply a message saying that the page is not a styled document.

If a [Document](#) stops being an *unstyled document*, then the conditions above stop applying, and thus a user agent following these requirements will switch to using the regular CSS rendering.

## 16 Obsolete features

### 16.1 Obsolete but conforming features

Features listed in this section will trigger warnings in conformance checkers.

Authors should not specify a [border](#) attribute on an [img](#) element. If the attribute is present, its value must be the string "`0`". CSS should be used instead.

Authors should not specify a [charset](#) attribute on a [script](#) element. If the attribute is present, its value must be an [ASCII case-insensitive](#) match for "`utf-8`". (This has no effect in a document that conforms to the requirements elsewhere in this standard of being encoded as [UTF-8](#).)

Authors should not specify a [language](#) attribute on a [script](#) element. If the attribute is present, its value must be an [ASCII case-insensitive](#) match for the string "`JavaScript`" and either the [type](#) attribute must be omitted or its value must be an [ASCII case-insensitive](#) match for the string "`text/javascript`". The attribute should be entirely omitted instead (with the value "`JavaScript`", it has no effect), or replaced with use of the [type](#) attribute.

Authors should not specify a value for the [type](#) attribute on [script](#) elements that is the empty string or a [JavaScript MIME type essence match](#). Instead, they should omit the attribute, which has the same effect.

Authors should not specify a [type](#) attribute on a [style](#) element. If the attribute is present, its value must be an [ASCII case-insensitive](#) match for "`text/css`".

Authors should not specify the [name](#) attribute on [a](#) elements. If the attribute is present, its value must not be the empty string and must neither be equal to the value of any of the [IDs](#) in the element's [tree](#) other than the element's own [ID](#), if any, nor be equal to the value of any of the other [name](#) attributes on [a](#) elements in the element's [tree](#). If this attribute is present and the

element has an [ID](#), then the attribute's value must be equal to the element's [ID](#). In earlier versions of the language, this attribute was intended as a way to specify possible targets for [fragments](#) in [URLs](#). The [id](#) attribute should be used instead.

Authors should not, but may despite requirements to the contrary elsewhere in this specification, specify the [maxlength](#) and [size](#) attributes on [input](#) elements whose [type](#) attributes are in the [Number](#) state. One valid reason for using these attributes regardless is to help legacy user agents that do not support [input](#) elements with `type="number"` to still render the text control with a useful width.

#### 16.1.1 Warnings for obsolete but conforming features

To ease the transition from HTML4 Transitional documents to the language defined in *this* specification, and to discourage certain features that are only allowed in very few circumstances, conformance checkers must warn the user when the following features are used in a document. These are generally old obsolete features that have no effect, and are allowed only to distinguish between likely mistakes (regular conformance errors) and mere vestigial markup or unusual and discouraged practices (these warnings).

The following features must be categorized as described above:

- The presence of a [border](#) attribute on an [img](#) element if its value is the string "0".
- The presence of a [charset](#) attribute on a [script](#) element if its value is an [ASCII case-insensitive](#) match for "utf-8".
- The presence of a [language](#) attribute on a [script](#) element if its value is an [ASCII case-insensitive](#) match for the string "JavaScript" and if there is no [type](#) attribute or there is and its value is an [ASCII case-insensitive](#) match for the string "text/javascript".
- The presence of a [type](#) attribute on a [script](#) element if its value is a [JavaScript MIME type essence match](#).
- The presence of a [type](#) attribute on a [style](#) element if its value is an [ASCII case-insensitive](#) match for "text/css".
- The presence of a [name](#) attribute on an [a](#) element, if its value is not the empty string.
- The presence of a [maxlength](#) attribute on an [input](#) element whose [type](#) attribute is in the [Number](#) state.
- The presence of a [size](#) attribute on an [input](#) element whose [type](#) attribute is in the [Number](#) state.

Conformance checkers must distinguish between pages that have no conformance errors and have none of these obsolete features, and pages that have no conformance errors but do have

some of these obsolete features.

For example, a validator could report some pages as "Valid HTML" and others as "Valid HTML with warnings".

## 16.2 Non-conforming features

Elements in the following list are entirely obsolete, and must not be used by authors:

### ***applet***

Use [embed](#) or [object](#) instead.

### ***acronym***

Use [abbr](#) instead.

### ***bgsound***

Use [audio](#) instead.

### ***dir***

Use [ul](#) instead.

### ***frame***

### ***frameset***

### ***noframes***

Either use [iframe](#) and CSS instead, or use server-side includes to generate complete pages with the various invariant parts merged in.

### ***isindex***

Use an explicit [form](#) and [text control](#) combination instead.

### ***keygen***

For enterprise device management use cases, use native on-device management capabilities.

For certificate enrollment use cases, use the Web Cryptography API to generate a keypair for the certificate, and then export the certificate and key to allow the user to install them manually. [\[WEBCRYPTO\]](#)

## ***listing***

Use [pre](#) and [code](#) instead.

## ***menuitem***

To implement a custom context menu, use script to handle the [contextmenu](#) event.

## ***nextid***

Use GUIDs instead.

## ***noembed***

Use [object](#) instead of [embed](#) when fallback is necessary.

## ***plaintext***

Use the "[text/plain](#)" [MIME type](#) instead.

## ***rb***

## ***rtc***

Providing the ruby base directly inside the [ruby](#) element or using nested [ruby](#) elements is sufficient.

## ***strike***

Use [del](#) instead if the element is marking an edit, otherwise use [s](#) instead.

## ***xmp***

Use [pre](#) and [code](#) instead, and escape "<" and "&" characters as "&lt;" and "&amp;" respectively.

## ***basefont***

## ***big***

## ***blink***

## ***center***

## ***font***

## ***marquee***

## ***multicol***

## ***nobr***

## ***spacer***

## ***tt***

Use appropriate elements or CSS instead.

Where the [tt](#) element would have been used for marking up keyboard input, consider the [kbd](#) element; for variables, consider the [var](#) element; for computer code, consider the [code](#) element; and for computer output, consider the [samp](#) element.

Similarly, if the [big](#) element is being used to denote a heading, consider using the [h1](#) element; if it is being used for marking up important passages, consider the [strong](#) element; and if it is being used for highlighting text for reference purposes, consider the [mark](#) element.

See also the [text-level semantics usage summary](#) for more suggestions with examples.

---

The following attributes are obsolete (though the elements are still part of the language), and must not be used by authors:

**charset** on [a](#) elements

**charset** on [link](#) elements

Use an HTTP '[Content-Type](#)' header on the linked resource instead.

**charset** on [script](#) elements (except as noted in the previous section)

Omit the attribute. Both documents and scripts are required to use [UTF-8](#), so it is redundant to specify it on the [script](#) element since it inherits from the document.

**coords** on [a](#) elements

**shape** on [a](#) elements

Use [area](#) instead of [a](#) for image maps.

**methods** on [a](#) elements

**methods** on [link](#) elements

Use the HTTP OPTIONS feature instead.

**name** on [a](#) elements (except as noted in the previous section)

**name** on [embed](#) elements

**name** on [img](#) elements

**name** on [option](#) elements

Use the [id](#) attribute instead.

**rev** on [a](#) elements

**rev** on [link](#) elements

Use the [rel](#) attribute instead, with an opposite term. (For example, instead of `rev="made"`, use `rel="author"`.)

**urn** on [a](#) elements

**urn** on [link](#) elements

Specify the preferred persistent identifier using the [href](#) attribute instead.

**accept** on [form](#) elements

Use the [accept](#) attribute directly on the [input](#) elements instead.

**hreflang** on [area](#) elements

**type** on [area](#) elements

These attributes do not do anything useful, and for historical reasons there are no corresponding IDL attributes on [area](#) elements. Omit them altogether.

**nohref** on [area](#) elements

Omitting the [href](#) attribute is sufficient; the [nohref](#) attribute is unnecessary. Omit it altogether.

**profile** on [head](#) elements

Unnecessary. Omit it altogether.

**manifest** on [html](#) elements

Use service workers instead. [\[SW\]](#)

**version** on [html](#) elements

Unnecessary. Omit it altogether.

**ismap** on [input](#) elements

Unnecessary. Omit it altogether. All [input](#) elements with a [type](#) attribute in the [Image Button](#) state are processed as server-side image maps.

**usemap** on [input](#) elements

**usemap** on [object](#) elements

Use the [img](#) element for image maps.

**longdesc** on [iframe](#) elements

**longdesc** on [img](#) elements

Use a regular [a](#) element to link to the description, or (in the case of images) use an [image map](#) to provide a link from the image to the image's description.

## **lowsrc** on [img](#) elements

Use a progressive JPEG image (given in the [src](#) attribute), instead of using two separate images.

## **target** on [link](#) elements

Unnecessary. Omit it altogether.

## **type** on [menu](#) elements

To implement a custom context menu, use script to handle the [contextmenu](#) event. For toolbar menus, omit the attribute.

## **label** on [menu](#) elements

**contextmenu** on all elements

**onshow** on all elements

To implement a custom context menu, use script to handle the [contextmenu](#) event.

## **scheme** on [meta](#) elements

Use only one scheme per field, or make the scheme declaration part of the value.

## **archive** on [object](#) elements

**classid** on [object](#) elements

**code** on [object](#) elements

**codebase** on [object](#) elements

**codetype** on [object](#) elements

Use the [data](#) and [type](#) attributes to invoke [plugins](#). To set parameters with these names in particular, the [param](#) element can be used.

## **declare** on [object](#) elements

Repeat the [object](#) element completely each time the resource is to be reused.

## **standby** on [object](#) elements

Optimize the linked resource so that it loads quickly or, at least, incrementally.

## **typemustmatch** on [object](#) elements

Avoid using [object](#) elements with untrusted resources.

**type** on [param](#) elements

**valuetype** on [param](#) elements

Use the [name](#) and [value](#) attributes without declaring value types.

**language** on [script](#) elements (except as noted in the previous section)

Omit the attribute for JavaScript; for [data blocks](#), use the [type](#) attribute instead.

**event** on [script](#) elements

**for** on [script](#) elements

Use DOM events mechanisms to register event listeners. [\[DOM\]](#)

**type** on [style](#) elements (except as noted in the previous section)

Omit the attribute for CSS; for [data blocks](#), use [script](#) as the container instead of [style](#).

**datapagesize** on [table](#) elements

Unnecessary. Omit it altogether.

**summary** on [table](#) elements

Use one of the [techniques for describing tables](#) given in the [table](#) section instead.

**abbr** on [td](#) elements

Use text that begins in an unambiguous and terse manner, and include any more elaborate text after that. The [title](#) attribute can also be useful in including more detailed text, so that the cell's contents can be made terse. If it's a heading, use [th](#) (which has an [abbr](#) attribute).

**axis** on [td](#) and [th](#) elements

Use the [scope](#) attribute on the relevant [th](#).

**scope** on [td](#) elements

Use [th](#) elements for heading cells.

**datasrc** on [a](#), [button](#), [div](#), [frame](#), [iframe](#), [img](#), [input](#), [label](#), [legend](#), [marquee](#), [object](#), [option](#), [select](#), [span](#), [table](#), and [textarea](#) elements

**datafld** on [a](#), [button](#), [div](#), [fieldset](#), [frame](#), [iframe](#), [img](#), [input](#), [label](#), [legend](#), [marquee](#), [object](#), [param](#), [select](#), [span](#), and [textarea](#) elements

**dataformatas** on [button](#), [div](#), [input](#), [label](#), [legend](#), [marquee](#), [object](#), [option](#), [select](#), [span](#), and [table](#) elements

Use script and a mechanism such as [XMLHttpRequest](#) to populate the page dynamically.  
[\[XHR\]](#)

**dropzone** on all elements

Use script to handle the [dragenter](#) and [dragover](#) events instead.

***alink*** on [body](#) elements  
***bgcolor*** on [body](#) elements  
***bottommargin*** on [body](#) elements  
***leftmargin*** on [body](#) elements  
***link*** on [body](#) elements  
***marginheight*** on [body](#) elements  
***marginwidth*** on [body](#) elements  
***rightmargin*** on [body](#) elements  
***text*** on [body](#) elements  
***topmargin*** on [body](#) elements  
***vlink*** on [body](#) elements  
***clear*** on [br](#) elements  
***align*** on [caption](#) elements  
***align*** on [col](#) elements  
***char*** on [col](#) elements  
***charoff*** on [col](#) elements  
***valign*** on [col](#) elements  
***width*** on [col](#) elements  
***align*** on [div](#) elements  
***compact*** on [dl](#) elements  
***align*** on [embed](#) elements  
***hspace*** on [embed](#) elements  
***vspace*** on [embed](#) elements  
***align*** on [hr](#) elements  
***color*** on [hr](#) elements  
***noshade*** on [hr](#) elements  
***size*** on [hr](#) elements  
***width*** on [hr](#) elements  
***align*** on [h1](#)—[h6](#) elements  
***align*** on [iframe](#) elements  
***allowtransparency*** on [iframe](#) elements  
***frameborder*** on [iframe](#) elements  
***framespacing*** on [iframe](#) elements  
***hspace*** on [iframe](#) elements  
***marginheight*** on [iframe](#) elements  
***marginwidth*** on [iframe](#) elements  
***scrolling*** on [iframe](#) elements  
***vspace*** on [iframe](#) elements  
***align*** on [input](#) elements  
***border*** on [input](#) elements  
***hspace*** on [input](#) elements  
***vspace*** on [input](#) elements  
***align*** on [img](#) elements  
***border*** on [img](#) elements (except as noted in the previous section)  
***hspace*** on [img](#) elements

**vspace** on [img](#) elements  
**align** on [legend](#) elements  
**type** on [li](#) elements  
**compact** on [menu](#) elements  
**align** on [object](#) elements  
**border** on [object](#) elements  
**hspace** on [object](#) elements  
**vspace** on [object](#) elements  
**compact** on [ol](#) elements  
**align** on [p](#) elements  
**width** on [pre](#) elements  
**align** on [table](#) elements  
**bgcolor** on [table](#) elements  
**border** on [table](#) elements  
**bordercolor** on [table](#) elements  
**cellpadding** on [table](#) elements  
**cellspacing** on [table](#) elements  
**frame** on [table](#) elements  
**height** on [table](#) elements  
**rules** on [table](#) elements  
**width** on [table](#) elements  
**align** on [tbody](#), [thead](#), and [tfoot](#) elements  
**char** on [tbody](#), [thead](#), and [tfoot](#) elements  
**charoff** on [tbody](#), [thead](#), and [tfoot](#) elements  
**height** on [thead](#), [tbody](#), and [tfoot](#) elements  
**valign** on [tbody](#), [thead](#), and [tfoot](#) elements  
**align** on [td](#) and [th](#) elements  
**bgcolor** on [td](#) and [th](#) elements  
**char** on [td](#) and [th](#) elements  
**charoff** on [td](#) and [th](#) elements  
**height** on [td](#) and [th](#) elements  
**nowrap** on [td](#) and [th](#) elements  
**valign** on [td](#) and [th](#) elements  
**width** on [td](#) and [th](#) elements  
**align** on [tr](#) elements  
**bgcolor** on [tr](#) elements  
**char** on [tr](#) elements  
**charoff** on [tr](#) elements  
**height** on [tr](#) elements  
**valign** on [tr](#) elements  
**compact** on [ul](#) elements  
**type** on [ul](#) elements  
**background** on [body](#), [table](#), [thead](#), [tbody](#), [tfoot](#), [tr](#), [td](#), and [th](#) elements

Use CSS instead.

## 16.3 Requirements for implementations

### 16.3.1 The **marquee** element

The [marquee](#) element is a presentational element that animates content. CSS transitions and animations are a more appropriate mechanism. [\[CSSANIMATIONS\]](#) [\[CSSTRANSITIONS\]](#)

The [marquee](#) element must implement the [HTMLMarqueeElement](#) interface.

```
[Exposed=Window]
interface HTMLMarqueeElement : HTMLElement {
 [HTMLConstructor] constructor();

 [CEReactions] attribute DOMString behavior;
 [CEReactions] attribute DOMString bgColor;
 [CEReactions] attribute DOMString direction;
 [CEReactions] attribute DOMString height;
 [CEReactions] attribute unsigned long hspace;
 [CEReactions] attribute long loop;
 [CEReactions] attribute unsigned long scrollAmount;
 [CEReactions] attribute unsigned long scrollDelay;
 [CEReactions] attribute boolean trueSpeed;
 [CEReactions] attribute unsigned long vspace;
 [CEReactions] attribute DOMString width;

 undefined start();
 undefined stop();
};
```

A [marquee](#) element can be *turned on* or *turned off*. When it is created, it is [turned on](#).

When the [start\(\)](#) method is called, the [marquee](#) element must be [turned on](#).

When the [stop\(\)](#) method is called, the [marquee](#) element must be [turned off](#).

---

The *behavior* content attribute on [marquee](#) elements is an [enumerated attribute](#) with the following keywords (all non-conforming):

| Keyword   | State     |
|-----------|-----------|
| scroll    | scroll    |
| slide     | slide     |
| alternate | alternate |

---

The [missing value default](#) and [invalid value default](#) are the [scroll](#) state.

The *direction* content attribute on [marquee](#) elements is an [enumerated attribute](#) with the following keywords (all non-conforming):

Keyword State

**left** *left*

**right** *right*

**up** *up*

**down** *down*

The [missing value default](#) and [invalid value default](#) are the [left](#) state.

---

The *truespeed* content attribute on [marquee](#) elements is a [boolean attribute](#).

---

A [marquee](#) element has a *marquee scroll interval*, which is obtained as follows:

1. If the element has a [scrolldelay](#) attribute, and parsing its value using the [rules for parsing non-negative integers](#) does not return an error, then let *delay* be the parsed value. Otherwise, let *delay* be 85.
  2. If the element does not have a [truespeed](#) attribute, and the *delay* value is less than 60, then let *delay* be 60 instead.
  3. The [marquee scroll interval](#) is *delay*, interpreted in milliseconds.
- 

A [marquee](#) element has a *marquee scroll distance*, which, if the element has a [scrollamount](#) attribute, and parsing its value using the [rules for parsing non-negative integers](#) does not return an error, is the parsed value interpreted in [CSS pixels](#), and otherwise is 6 [CSS pixels](#).

---

A [marquee](#) element has a *marquee loop count*, which, if the element has a [loop](#) attribute, and parsing its value using the [rules for parsing integers](#) does not return an error or a number less than 1, is the parsed value, and otherwise is -1.

The [loop](#) IDL attribute, on getting, must return the element's [marquee loop count](#); and on setting, if the new value is different than the element's [marquee loop count](#) and either greater than zero or equal to -1, must set the element's [loop](#) content attribute (adding it if necessary) to the [valid integer](#) that represents the new value. (Other values are ignored.)

A [marquee](#) element also has a *marquee current loop index*, which is zero when the element is created.

The rendering layer will occasionally *increment the marquee current loop index*, which must cause the following steps to be run:

1. If the [marquee loop count](#) is  $-1$ , then return.
  2. Increment the [marquee current loop index](#) by one.
  3. If the [marquee current loop index](#) is now equal to or greater than the element's [marquee loop count](#), [turn off](#) the [marquee](#) element.
- 

The *behavior*, *direction*, *height*, *hspace*, *vspace*, and *width* IDL attributes must [reflect](#) the respective content attributes of the same name.

The *bgColor* IDL attribute must [reflect](#) the [bgcolor](#) content attribute.

The *scrollAmount* IDL attribute must [reflect](#) the [scrollamount](#) content attribute. The default value is 6.

The *scrollDelay* IDL attribute must [reflect](#) the [scrolldelay](#) content attribute. The default value is 85.

The *trueSpeed* IDL attribute must [reflect](#) the [truespeed](#) content attribute.

### 16.3.2 Frames

The *frameset* element acts as [the body element](#) in documents that use frames.

The [frameset](#) element must implement the [HTMLFrameSetElement](#) interface.

```
[Exposed=Window]
interface HTMLFrameSetElement : HTMLElement {
 [HTMLConstructor] constructor();
 [CEReactions] attribute DOMString cols;
 [CEReactions] attribute DOMString rows;
};
HTMLFrameSetElement includes WindowEventHandlers;
```

The *cols* and *rows* IDL attributes of the [frameset](#) element must [reflect](#) the respective content attributes of the same name.

The [frameset](#) element exposes as [event handler content attributes](#) a number of the [event handlers](#) of the [Window](#) object. It also mirrors their [event handler IDL attributes](#).

The [event handlers](#) of the [Window](#) object named by the [Window-reflecting body element event handler set](#), exposed on the [frameset](#) element, replace the generic [event handlers](#) with the same names normally supported by [HTML elements](#).

---

The `frame` element has a [nested browsing context](#) similar to the `iframe` element, but rendered within a `frameset` element.

A `frame` element is said to be an *active frame element* when it is [in a document](#).

When a `frame` element *element* is created as an [active frame element](#), or becomes an [active frame element](#) after not having been one, the user agent must run these steps:

1. [Create a new nested browsing context for element](#).
2. [Process the frame attributes for element, with initialInsertion set to true](#).

When a `frame` element stops being an [active frame element](#), the user agent must [discard](#) the element's [nested browsing context](#), and then set the element's [nested browsing context](#) to null.

Whenever a `frame` element with a non-null [nested browsing context](#) has its `src` attribute set, changed, or removed, the user agent must [process the frame attributes](#).

To process the `frame` attributes for an element *element*, with an optional boolean `initialInsertion`:

1. If *element* has a `src` attribute specified, or `initialInsertion` is false, then run the [shared attribute processing steps for iframe and frame elements](#) given *element* and `initialInsertion`.

The `frame` element [potentially delays the load event](#).

The `frame` element must implement the `HTMLFrameElement` interface.

```
[Exposed=Window]
interface HTMLFrameElement : HTMLElement {
 [HTMLConstructor] constructor();
 [CEReactions] attribute DOMString name;
 [CEReactions] attribute DOMString scrolling;
 [CEReactions] attribute USVString src;
 [CEReactions] attribute DOMString frameBorder;
 [CEReactions] attribute USVString longDesc;
 [CEReactions] attribute boolean noResize;
 readonly attribute Document? contentDocument;
 readonly attribute WindowProxy? contentWindow;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString marginHeight;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString marginWidth;
};
```

The `name`, `scrolling`, and `src` IDL attributes of the `frame` element must [reflect](#) the

respective content attributes of the same name. For the purposes of reflection, the [frame](#) element's `src` content attribute is defined as containing a [URL](#).

The `frameBorder` IDL attribute of the [frame](#) element must [reflect](#) the element's `frameborder` content attribute.

The `longDesc` IDL attribute of the [frame](#) element must [reflect](#) the element's `longdesc` content attribute, which for the purposes of reflection is defined as containing a [URL](#).

The `noResize` IDL attribute of the [frame](#) element must [reflect](#) the element's `noresize` content attribute.

The `contentDocument` IDL attribute, on getting, must return the [frame](#) element's [content document](#).

The `contentWindow` IDL attribute must return the [WindowProxy](#) object of the [frame](#) element's [nested browsing context](#), if the element's [nested browsing context](#) is non-null, or return null otherwise.

The `marginHeight` IDL attribute of the [frame](#) element must [reflect](#) the element's `marginheight` content attribute.

The `marginWidth` IDL attribute of the [frame](#) element must [reflect](#) the element's `marginwidth` content attribute.

### 16.3.3 Other elements, attributes and APIs

User agents must treat [acronym](#) elements in a manner equivalent to [abbr](#) elements in terms of semantics and for purposes of rendering.

---

```
partial interface HTMLAnchorElement {
 [CEReactions] attribute DOMString coords;
 [CEReactions] attribute DOMString charset;
 [CEReactions] attribute DOMString name;
 [CEReactions] attribute DOMString rev;
 [CEReactions] attribute DOMString shape;
};
```

The `coords`, `charset`, `name`, `rev`, and `shape` IDL attributes of the [a](#) element must [reflect](#) the respective content attributes of the same name.

---

```
partial interface HTMLAreaElement {
 [CEReactions] attribute boolean noHref;
};
```

The *noHref* IDL attribute of the [area](#) element must reflect the element's [nohref](#) content attribute.

---

```
partial interface HTMLBodyElement {
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString text;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString link;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString vLink;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString aLink;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString bgColor;
 [CEReactions] attribute DOMString background;
};
```

The *text* IDL attribute of the [body](#) element must reflect the element's [text](#) content attribute.

The *link* IDL attribute of the [body](#) element must reflect the element's [link](#) content attribute.

The *aLink* IDL attribute of the [body](#) element must reflect the element's [alink](#) content attribute.

The *vLink* IDL attribute of the [body](#) element must reflect the element's [vlink](#) content attribute.

The *bgColor* IDL attribute of the [body](#) element must reflect the element's [bgcolor](#) content attribute.

The *background* IDL attribute of the [body](#) element must reflect the element's [background](#) content attribute. (The [background](#) content is *not* defined to contain a [URL](#), despite rules regarding its handling in the Rendering section above.)

---

```
partial interface HTMLBRElement {
 [CEReactions] attribute DOMString clear;
};
```

The *clear* IDL attribute of the [br](#) element must reflect the content attribute of the same name.

---

```
partial interface HTMLTableCaptionElement {
 [CEReactions] attribute DOMString align;
};
```

The *align* IDL attribute of the [caption](#) element must reflect the content attribute of the same name.

---

```
partial interface HTMLTableColElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString ch;
 [CEReactions] attribute DOMString chOff;
 [CEReactions] attribute DOMString vAlign;
 [CEReactions] attribute DOMString width;
};
```

The *align* and *width* IDL attributes of the [col](#) element must [reflect](#) the respective content attributes of the same name.

The *ch* IDL attribute of the [col](#) element must [reflect](#) the element's [char](#) content attribute.

The *chOff* IDL attribute of the [col](#) element must [reflect](#) the element's [charoff](#) content attribute.

The *vAlign* IDL attribute of the [col](#) element must [reflect](#) the element's [valign](#) content attribute.

---

User agents must treat [dir](#) elements in a manner equivalent to [ul](#) elements in terms of semantics and for purposes of rendering.

The [dir](#) element must implement the [HTMLDirectoryElement](#) interface.

```
[Exposed=Window]
interface HTMLDirectoryElement : HTMLElement {
 [HTMLConstructor] constructor();
 [CEReactions] attribute boolean compact;
};
```

The *compact* IDL attribute of the [dir](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLDivElement {
 [CEReactions] attribute DOMString align;
};
```

The *align* IDL attribute of the [div](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLListElement {
 [CEReactions] attribute boolean compact;
};
```

The *compact* IDL attribute of the [dl](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLEmbedElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString name;
};
```

The *name* and *align* IDL attributes of the [embed](#) element must [reflect](#) the respective content attributes of the same name.

---

The [font](#) element must implement the [HTMLFontElement](#) interface.

```
[Exposed=Window]
interface HTMLFontElement : HTMLElement {
 [HTMLConstructor] constructor();

 [CEReactions] attribute [LegacyNullToEmptyString] DOMString color;
 [CEReactions] attribute DOMString face;
 [CEReactions] attribute DOMString size;
};
```

The *color*, *face*, and *size* IDL attributes of the [font](#) element must [reflect](#) the respective content attributes of the same name.

---

```
partial interface HTMLHeadingElement {
 [CEReactions] attribute DOMString align;
};
```

The *align* IDL attribute of the [h1–h6](#) elements must [reflect](#) the content attribute of the same name.

---

The *profile* IDL attribute on [head](#) elements (with the [HTMLHeadElement](#) interface) is intentionally omitted. Unless so required by [another applicable specification](#), implementations would therefore not support this attribute. (It is mentioned here as it was defined in a previous version of *DOM*.)

---

```
partial interface HTMLHRElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString color;
 [CEReactions] attribute boolean noShade;
 [CEReactions] attribute DOMString size;
};
```

```
[CEReactions] attribute DOMString width;
};
```

The *align*, *color*, *size*, and *width* IDL attributes of the [hr](#) element must [reflect](#) the respective content attributes of the same name.

The *noShade* IDL attribute of the [hr](#) element must [reflect](#) the element's [noshade](#) content attribute.

---

```
partial interface HTMLHtmlElement {
 [CEReactions] attribute DOMString version;
};
```

The *version* IDL attribute of the [html](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLIFrameElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString scrolling;
 [CEReactions] attribute DOMString frameBorder;
 [CEReactions] attribute USVString longDesc;

 [CEReactions] attribute [LegacyNullToEmptyString] DOMString marginHeight;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString marginWidth;
};
```

The *align* and *scrolling* IDL attributes of the [iframe](#) element must [reflect](#) the respective content attributes of the same name.

The *frameBorder* IDL attribute of the [iframe](#) element must [reflect](#) the element's [frameborder](#) content attribute.

The *longDesc* IDL attribute of the [iframe](#) element must [reflect](#) the element's [longdesc](#) content attribute, which for the purposes of reflection is defined as containing a [URL](#).

The *marginHeight* IDL attribute of the [iframe](#) element must [reflect](#) the element's [marginheight](#) content attribute.

The *marginWidth* IDL attribute of the [iframe](#) element must [reflect](#) the element's [marginwidth](#) content attribute.

---

```
partial interface HTMLImageElement {
 [CEReactions] attribute DOMString name;
 [CEReactions] attribute USVString lowsrc;
```

```
[CEReactions] attribute DOMString align;
[CEReactions] attribute unsigned long hspace;
[CEReactions] attribute unsigned long vspace;
[CEReactions] attribute USVString longDesc;

[CEReactions] attribute [LegacyNullToEmptyString] DOMString border;
};
```

The *name*, *align*, *border*, *hspace*, and *vspace* IDL attributes of the `img` element must reflect the respective content attributes of the same name.

The *longDesc* IDL attribute of the `img` element must reflect the element's `longdesc` content attribute, which for the purposes of reflection is defined as containing a URL.

The *lowsrc* IDL attribute of the `img` element must reflect the element's `lowsrc` content attribute, which for the purposes of reflection is defined as containing a URL.

---

```
partial interface HTMLInputElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString useMap;
};
```

The *align* IDL attribute of the `input` element must reflect the content attribute of the same name.

The *useMap* IDL attribute of the `input` element must reflect the element's `usemap` content attribute.

---

```
partial interface HTMLLegendElement {
 [CEReactions] attribute DOMString align;
};
```

The *align* IDL attribute of the `legend` element must reflect the content attribute of the same name.

---

```
partial interface HTMLLIElement {
 [CEReactions] attribute DOMString type;
};
```

The *type* IDL attribute of the `li` element must reflect the content attribute of the same name.

---

```
partial interface HTMLLinkElement {
 [CEReactions] attribute DOMString charset;
```

```
[CEReactions] attribute DOMString rev;
[CEReactions] attribute DOMString target;
};
```

The *charset*, *rev*, and *target* IDL attributes of the [link](#) element must [reflect](#) the respective content attributes of the same name.

---

User agents must treat [listing](#) elements in a manner equivalent to [pre](#) elements in terms of semantics and for purposes of rendering.

---

```
partial interface HTMLMenuElement {
 [CEReactions] attribute boolean compact;
};
```

The *compact* IDL attribute of the [menu](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLMetaElement {
 [CEReactions] attribute DOMString scheme;
};
```

User agents may treat the [scheme](#) content attribute on the [meta](#) element as an extension of the element's [name](#) content attribute when processing a [meta](#) element with a [name](#) attribute whose value is one that the user agent recognizes as supporting the [scheme](#) attribute.

User agents are encouraged to ignore the [scheme](#) attribute and instead process the value given to the metadata name as if it had been specified for each expected value of the [scheme](#) attribute.

For example, if the user agent acts on [meta](#) elements with [name](#) attributes having the value "eGMS.subject.keyword", and knows that the [scheme](#) attribute is used with this metadata name, then it could take the [scheme](#) attribute into account, acting as if it was an extension of the [name](#) attribute. Thus the following two [meta](#) elements could be treated as two elements giving values for two different metadata names, one consisting of a combination of "eGMS.subject.keyword" and "LGCL", and the other consisting of a combination of "eGMS.subject.keyword" and "ORLY":

```
<!-- this markup is invalid -->
<meta name="eGMS.subject.keyword" scheme="LGCL" content="Abandoned vehicles">
<meta name="eGMS.subject.keyword" scheme="ORLY" content="Mah car: kthxbye">
```

The suggested processing of this markup, however, would be equivalent to the following:

```
<meta name="eGMS.subject.keyword" content="Abandoned vehicles">
```

```
<meta name="eGMS.subject.keyword" content="Mah car: kthxbye">
```

The *scheme* IDL attribute of the [meta](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLObjectElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString archive;
 [CEReactions] attribute DOMString code;
 [CEReactions] attribute boolean declare;
 [CEReactions] attribute unsigned long hspace;
 [CEReactions] attribute DOMString standby;
 [CEReactions] attribute unsigned long vspace;
 [CEReactions] attribute DOMString codeBase;
 [CEReactions] attribute DOMString codeType;
 [CEReactions] attribute DOMString useMap;

 [CEReactions] attribute [LegacyNullToEmptyString] DOMString border;
};
```

The *align*, *archive*, *border*, *code*, *declare*, *hspace*, *standby*, and *vspace* IDL attributes of the [object](#) element must [reflect](#) the respective content attributes of the same name.

The *codeBase* IDL attribute of the [object](#) element must [reflect](#) the element's [codebase](#) content attribute, which for the purposes of reflection is defined as containing a [URL](#).

The *codeType* IDL attribute of the [object](#) element must [reflect](#) the element's [codetype](#) content attribute.



## [HTMLObjectElement/useMap](#)

Support in all current engines.

Firefox 1+ Safari 3+ Chrome 1+

---

Opera 12.1+ Edge 79+

---

Edge (Legacy) 12+ Internet Explorer 6+

---

Firefox Android 4+ Safari iOS 1+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12.1+

The *useMap* IDL attribute must [reflect](#) the [usemap](#) content attribute.

---

```
partial interface HTMLListElement {
 [CEReactions] attribute boolean compact;
};
```

The *compact* IDL attribute of the [ol](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLParagraphElement {
 [CEReactions] attribute DOMString align;
};
```

The *align* IDL attribute of the [p](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLParamElement {
 [CEReactions] attribute DOMString type;
 [CEReactions] attribute DOMString valueType;
};
```

The *type* IDL attribute of the [param](#) element must [reflect](#) the content attribute of the same name.

The *valueType* IDL attribute of the [param](#) element must [reflect](#) the element's [valuetype](#) content attribute.

---

User agents must treat [plaintext](#) elements in a manner equivalent to [pre](#) elements in terms of semantics and for purposes of rendering. (The parser has special behavior for this element, though.)

---

```
partial interface HTMLPreElement {
 [CEReactions] attribute long width;
};
```

The *width* IDL attribute of the [pre](#) element must [reflect](#) the content attribute of the same name.

---

```
partial interface HTMLStyleElement {
 [CEReactions] attribute DOMString type;
};
```

The *type* IDL attribute of the [style](#) element must [reflect](#) the element's [type](#) content attribute.

---

```
partial interface HTMLScriptElement {
 [CEReactions] attribute DOMString charset;
 [CEReactions] attribute DOMString event;
 [CEReactions] attribute DOMString htmlFor;
};
```

The *charset* and *event* IDL attributes of the [script](#) element must [reflect](#) the respective content attributes of the same name.

The *htmlFor* IDL attribute of the [script](#) element must [reflect](#) the element's [for](#) content attribute.

---

```
partial interface HTMLTableElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString border;
 [CEReactions] attribute DOMString frame;
 [CEReactions] attribute DOMString rules;
 [CEReactions] attribute DOMString summary;
 [CEReactions] attribute DOMString width;

 [CEReactions] attribute [LegacyNullToEmptyString] DOMString bgColor;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString cellPadding;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString cellSpacing;
};
```

The *align*, *border*, *frame*, *summary*, *rules*, and *width*, IDL attributes of the [table](#) element must [reflect](#) the respective content attributes of the same name.

The *bgColor* IDL attribute of the [table](#) element must [reflect](#) the element's [bgcolor](#) content attribute.

The *cellPadding* IDL attribute of the [table](#) element must [reflect](#) the element's [cellpadding](#) content attribute.

The *cellSpacing* IDL attribute of the [table](#) element must [reflect](#) the element's [cellspacing](#) content attribute.

---

```
partial interface HTMLTableSectionElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString ch;
 [CEReactions] attribute DOMString chOff;
 [CEReactions] attribute DOMString vAlign;
};
```

The *align* IDL attribute of the [tbody](#), [thead](#), and [tfoot](#) elements must [reflect](#) the content

attribute of the same name.

The *ch* IDL attribute of the [tbody](#), [thead](#), and [tfoot](#) elements must [reflect](#) the elements' [char](#) content attributes.

The *chOff* IDL attribute of the [tbody](#), [thead](#), and [tfoot](#) elements must [reflect](#) the elements' [charoff](#) content attributes.

The *vAlign* IDL attribute of the [tbody](#), [thead](#), and [tfoot](#) element must [reflect](#) the elements' [valign](#) content attributes.

---

```
partial interface HTMLTableCellElement {
 [CEReactions] attribute DOMString align;
 [CEReactions] attribute DOMString axis;
 [CEReactions] attribute DOMString height;
 [CEReactions] attribute DOMString width;

 [CEReactions] attribute DOMString ch;
 [CEReactions] attribute DOMString chOff;
 [CEReactions] attribute boolean noWrap;
 [CEReactions] attribute DOMString vAlign;

 [CEReactions] attribute [LegacyNullToEmptyString] DOMString bgColor;
};
```

The *align*, *axis*, *height*, and *width* IDL attributes of the [td](#) and [th](#) elements must [reflect](#) the respective content attributes of the same name.

The *ch* IDL attribute of the [td](#) and [th](#) elements must [reflect](#) the elements' [char](#) content attributes.

The *chOff* IDL attribute of the [td](#) and [th](#) elements must [reflect](#) the elements' [charoff](#) content attributes.

The *nowrap* IDL attribute of the [td](#) and [th](#) elements must [reflect](#) the elements' [nowrap](#) content attributes.

The *vAlign* IDL attribute of the [td](#) and [th](#) elements must [reflect](#) the elements' [valign](#) content attributes.

The *bgColor* IDL attribute of the [td](#) and [th](#) elements must [reflect](#) the elements' [bgcolor](#) content attributes.

---

```
partial interface HTMLTableRowElement {
 [CEReactions] attribute DOMString align;
```

```
[CEReactions] attribute DOMString ch;
[CEReactions] attribute DOMString chOff;
[CEReactions] attribute DOMString vAlign;

[CEReactions] attribute [LegacyNullToEmptyString] DOMString bgColor;
};
```

The *align* IDL attribute of the [tr](#) element must [reflect](#) the content attribute of the same name.

The *ch* IDL attribute of the [tr](#) element must [reflect](#) the element's [char](#) content attribute.

The *chOff* IDL attribute of the [tr](#) element must [reflect](#) the element's [charoff](#) content attribute.

The *vAlign* IDL attribute of the [tr](#) element must [reflect](#) the element's [valign](#) content attribute.

The *bgColor* IDL attribute of the [tr](#) element must [reflect](#) the element's [bgcolor](#) content attribute.

---

```
partial interface HTMLULListElement {
 [CEReactions] attribute boolean compact;
 [CEReactions] attribute DOMString type;
};
```

The *compact* and *type* IDL attributes of the [ul](#) element must [reflect](#) the respective content attributes of the same name.

---

User agents must treat [xmp](#) elements in a manner equivalent to [pre](#) elements in terms of semantics and for purposes of rendering. (The parser has special behavior for this element though.)

---

```
partial interface Document {
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString fgColor;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString linkColor;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString vlinkColor;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString alinkColor;
 [CEReactions] attribute [LegacyNullToEmptyString] DOMString bgColor;

 [SameObject] readonly attribute HTMLCollection anchors;
 [SameObject] readonly attribute HTMLCollection applets;

 undefined clear();
};
```

```
undefined captureEvents();
undefined releaseEvents();

[SameObject] readonly attribute HTMLAllCollection all;
};
```

The attributes of the [Document](#) object listed in the first column of the following table must reflect the content attribute on [the body element](#) with the name given in the corresponding cell in the second column on the same row, if [the body element](#) is a [body](#) element (as opposed to a [frameset](#) element). When there is no [body element](#) or if it is a [frameset](#) element, the attributes must instead return the empty string on getting and do nothing on setting.

IDL attribute Content attribute

|                   |                         |
|-------------------|-------------------------|
| <i>fgColor</i>    | <a href="#">text</a>    |
| <i>linkColor</i>  | <a href="#">link</a>    |
| <i>vlinkColor</i> | <a href="#">vlink</a>   |
| <i>alinkColor</i> | <a href="#">alink</a>   |
| <i>bgColor</i>    | <a href="#">bgcolor</a> |

---

The *anchors* attribute must return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches only [a](#) elements with [name](#) attributes.

The *applets* attribute must return an [HTMLCollection](#) rooted at the [Document](#) node, whose filter matches nothing. (It exists for historical reasons.)

The *clear()*, *captureEvents()*, and *releaseEvents()* methods must do nothing.

---

The *all* attribute must return an [HTMLAllCollection](#) rooted at the [Document](#) node, whose filter matches all elements.

---

```
partial interface Window {
 undefined captureEvents();
 undefined releaseEvents();

 [Replaceable, SameObject] readonly attribute External external;
};
```

The *captureEvents()* and *releaseEvents()* methods must do nothing.

The *external* attribute of the [Window](#) interface must return an instance of the [External](#) interface:

```
[Exposed=Window]
interface External {
```

```
undefined AddSearchProvider\(\);
undefined IsSearchProviderInstalled\(\);
};
```

The `AddSearchProvider()` and `IsSearchProviderInstalled()` methods must do nothing.

## 17 IANA considerations

### 17.1 ***text/html***

This registration is for community review and will be submitted to the IESG for review, approval, and registration with IANA.

Type name:

text

Subtype name:

html

Required parameters:

No required parameters

Optional parameters:

**charset**

The `charset` parameter may be provided to specify the [document's character encoding](#), overriding any [character encoding declarations](#) in the document other than a Byte Order Mark (BOM). The parameter's value must be an [ASCII case-insensitive](#) match for the string "`utf-8`". [\[ENCODING\]](#)

Encoding considerations:

8bit (see the section on [character encoding declarations](#))

Security considerations:

Entire novels have been written about the security considerations that apply to HTML documents. Many are listed in this document, to which the reader is referred for more details. Some general concerns bear mentioning here, however:

HTML is a scripted language, and has a large number of APIs (some of which are described in this document). Script can expose the user to potential risks of information leakage, credential leakage, cross-site scripting attacks, cross-site request forgeries, and a host of other problems. While the designs in this specification are intended to be safe if implemented correctly, a full implementation is a massive undertaking and, as with any software, user agents are likely to have security bugs.

Even without scripting, there are specific features in HTML which, for historical reasons, are required for broad compatibility with legacy content but that expose the user to unfortunate security problems. In particular, the [img](#) element can be used in conjunction with some other features as a way to effect a port scan from the user's location on the Internet. This can expose local network topologies that the attacker would otherwise not be able to determine.

HTML relies on a compartmentalization scheme sometimes known as the *same-origin policy*. An [origin](#) in most cases consists of all the pages served from the same host, on the same port, using the same protocol.

It is critical, therefore, to ensure that any untrusted content that forms part of a site be hosted on a different [origin](#) than any sensitive content on that site. Untrusted content can easily spoof any other page on the same origin, read data from that origin, cause scripts in that origin to execute, submit forms to and from that origin even if they are protected from cross-site request forgery attacks by unique tokens, and make use of any third-party resources exposed to or rights granted to that origin.

#### Interoperability considerations:

Rules for processing both conforming and non-conforming content are defined in this specification.

#### Published specification:

This document is the relevant specification. Labeling a resource with the [text/html](#) type asserts that the resource is an [HTML document](#) using [the HTML syntax](#).

#### Applications that use this media type:

Web browsers, tools for processing web content, HTML authoring tools, search engines, validators.

#### Additional information:

##### Magic number(s):

No sequence of bytes can uniquely identify an HTML document. More information on detecting HTML documents is available in *MIME Sniffing*. [\[MIMESNIFF\]](#)

##### File extension(s):

"`html`" and "`htm`" are commonly, but certainly not exclusively, used as the extension for HTML documents.

##### Macintosh file type code(s):

`TEXT`

#### Person & email address to contact for further information:

Ian Hickson <[ian@hixie.ch](mailto:ian@hixie.ch)>

#### Intended usage:

Common

**Restrictions on usage:**

No restrictions apply.

**Author:**

Ian Hickson <ian@hixie.ch>

**Change controller:**

W3C

[Fragments](#) used with [text/html](#) resources either refer to [the indicated part of the document](#) or provide state information for in-page scripts.

## 17.2 ***multipart/x-mixed-replace***

This registration is for community review and will be submitted to the IESG for review, approval, and registration with IANA.

**Type name:**

multipart

**Subtype name:**

x-mixed-replace

**Required parameters:**

- **boundary** (defined in RFC2046) [\[RFC2046\]](#)

**Optional parameters:**

No optional parameters.

**Encoding considerations:**

binary

**Security considerations:**

Subresources of a [multipart/x-mixed-replace](#) resource can be of any type, including types with non-trivial security implications such as [text/html](#).

**Interoperability considerations:**

None.

**Published specification:**

This specification describes processing rules for web browsers. Conformance requirements for generating resources with this type are the same as for [multipart/mixed](#). [\[RFC2046\]](#)

**Applications that use this media type:**

This type is intended to be used in resources generated by web servers, for consumption by web browsers.

**Additional information:**

**Magic number(s):**

No sequence of bytes can uniquely identify a [`multipart/x-mixed-replace`](#) resource.

**File extension(s):**

No specific file extensions are recommended for this type.

**Macintosh file type code(s):**

No specific Macintosh file type codes are recommended for this type.

**Person & email address to contact for further information:**

Ian Hickson <ian@hixie.ch>

**Intended usage:**

Common

**Restrictions on usage:**

No restrictions apply.

**Author:**

Ian Hickson <ian@hixie.ch>

**Change controller:**

W3C

[Fragments](#) used with [`multipart/x-mixed-replace`](#) resources apply to each body part as defined by the type used by that body part.

## 17.3 ***application/xhtml+xml***

This registration is for community review and will be submitted to the IESG for review, approval, and registration with IANA.

**Type name:**

application

**Subtype name:**

xhtml+xml

**Required parameters:**

Same as for [`application/xml`](#) [RFC7303]

**Optional parameters:**

Same as for [`application/xml`](#) [RFC7303]

**Encoding considerations:**

Same as for [`application/xml`](#) [RFC7303]

Security considerations:

Same as for [application/xml](#) [RFC7303]

Interoperability considerations:

Same as for [application/xml](#) [RFC7303]

Published specification:

Labeling a resource with the [application/xhtml+xml](#) type asserts that the resource is an XML document that likely has a [document element](#) from the [HTML namespace](#). Thus, the relevant specifications are *XML*, *Namespaces in XML*, and this specification. [\[XML\]](#) [\[XMLNS\]](#)

Applications that use this media type:

Same as for [application/xml](#) [RFC7303]

Additional information:

Magic number(s):

Same as for [application/xml](#) [RFC7303]

File extension(s):

"`xhtml`" and "`xht`" are sometimes used as extensions for XML resources that have a [document element](#) from the [HTML namespace](#).

Macintosh file type code(s):

TEXT

Person & email address to contact for further information:

Ian Hickson <ian@hixie.ch>

Intended usage:

Common

Restrictions on usage:

No restrictions apply.

Author:

Ian Hickson <ian@hixie.ch>

Change controller:

W3C

[Fragments](#) used with [application/xhtml+xml](#) resources have the same semantics as with any [XML MIME type](#). [\[RFC7303\]](#)

## 17.4 ***text/ping***

This registration is for community review and will be submitted to the IESG for review, approval, and registration with IANA.

Type name:

text

Subtype name:

ping

Required parameters:

No parameters

Optional parameters:

**charset**

The **charset** parameter may be provided. The parameter's value must be "**utf-8**".

This parameter serves no purpose; it is only allowed for compatibility with legacy servers.

Encoding considerations:

Not applicable.

Security considerations:

If used exclusively in the fashion described in the context of [hyperlink auditing](#), this type introduces no new security concerns.

Interoperability considerations:

Rules applicable to this type are defined in this specification.

Published specification:

This document is the relevant specification.

Applications that use this media type:

Web browsers.

Additional information:

Magic number(s):

[text/ping](#) resources always consist of the four bytes 0x50 0x49 0x4E 0x47 ('PING').

File extension(s):

No specific file extension is recommended for this type.

Macintosh file type code(s):

No specific Macintosh file type codes are recommended for this type.

Person & email address to contact for further information:

Ian Hickson <ian@hixie.ch>

Intended usage:

Common

**Restrictions on usage:**

Only intended for use with HTTP POST requests generated as part of a web browser's processing of the [ping](#) attribute.

**Author:**

Ian Hickson <ian@hixie.ch>

**Change controller:**

W3C

[Fragments](#) have no meaning with [text/ping](#) resources.

## 17.5 ***application/microdata+json***

This registration is for community review and will be submitted to the IESG for review, approval, and registration with IANA.

**Type name:**

application

**Subtype name:**

microdata+json

**Required parameters:**

Same as for [application/json \[JSON\]](#)

**Optional parameters:**

Same as for [application/json \[JSON\]](#)

**Encoding considerations:**

8bit (always UTF-8)

**Security considerations:**

Same as for [application/json \[JSON\]](#)

**Interoperability considerations:**

Same as for [application/json \[JSON\]](#)

**Published specification:**

Labeling a resource with the [application/microdata+json](#) type asserts that the resource is a JSON text that consists of an object with a single entry called "**items**" consisting of an array of entries, each of which consists of an object with an entry called "**id**" whose value is a string, an entry called "**type**" whose value is another string, and an entry called "**properties**" whose value is an object whose entries each have a value consisting of an array of either objects or strings, the objects being of the same form as the objects in the aforementioned "**items**" entry. Thus, the relevant specifications are [JSON](#) and this specification. [\[JSON\]](#)

**Applications that use this media type:**

Applications that transfer data intended for use with HTML's microdata feature, especially in the context of drag-and-drop, are the primary application class for this type.

**Additional information:**

**Magic number(s):**

Same as for [application/json](#) [JSON]

**File extension(s):**

Same as for [application/json](#) [JSON]

**Macintosh file type code(s):**

Same as for [application/json](#) [JSON]

**Person & email address to contact for further information:**

Ian Hickson <ian@hixie.ch>

**Intended usage:**

Common

**Restrictions on usage:**

No restrictions apply.

**Author:**

Ian Hickson <ian@hixie.ch>

**Change controller:**

W3C

[Fragments](#) used with [application/microdata+json](#) resources have the same semantics as when used with [application/json](#) (namely, at the time of writing, no semantics at all).  
[\[JSON\]](#)

## 17.6 ***text/event-stream***

This registration is for community review and will be submitted to the IESG for review, approval, and registration with IANA.

**Type name:**

text

**Subtype name:**

event-stream

**Required parameters:**

No parameters

Optional parameters:

### **charset**

The **charset** parameter may be provided. The parameter's value must be "**utf-8**". This parameter serves no purpose; it is only allowed for compatibility with legacy servers.

Encoding considerations:

8bit (always UTF-8)

Security considerations:

An event stream from an origin distinct from the origin of the content consuming the event stream can result in information leakage. To avoid this, user agents are required to apply CORS semantics. [\[FETCH\]](#)

Event streams can overwhelm a user agent; a user agent is expected to apply suitable restrictions to avoid depleting local resources because of an overabundance of information from an event stream.

Servers can be overwhelmed if a situation develops in which the server is causing clients to reconnect rapidly. Servers should use a 5xx status code to indicate capacity problems, as this will prevent conforming clients from reconnecting automatically.

Interoperability considerations:

Rules for processing both conforming and non-conforming content are defined in this specification.

Published specification:

This document is the relevant specification.

Applications that use this media type:

Web browsers and tools using web services.

Additional information:

Magic number(s):

No sequence of bytes can uniquely identify an event stream.

File extension(s):

No specific file extensions are recommended for this type.

Macintosh file type code(s):

No specific Macintosh file type codes are recommended for this type.

Person & email address to contact for further information:

Ian Hickson <ian@hixie.ch>

Intended usage:

Common

**Restrictions on usage:**

This format is only expected to be used by dynamic open-ended streams served using HTTP or a similar protocol. Finite resources are not expected to be labeled with this type.

**Author:**

Ian Hickson <ian@hixie.ch>

**Change controller:**

W3C

Fragments have no meaning with [text/event-stream](#) resources.

## 17.7 **web+** scheme prefix

This section describes a convention for use with the IANA URI scheme registry. It does not itself register a specific scheme. [\[RFC7595\]](#)

**Scheme name:**

Schemes starting with the four characters "web+" followed by one or more letters in the range a-z.

**Status:**

Permanent

**Scheme syntax:**

Scheme-specific.

**Scheme semantics:**

Scheme-specific.

**Encoding considerations:**

All "web+" schemes should use UTF-8 encodings where relevant.

**Applications/protocols that use this scheme name:**

Scheme-specific.

**Interoperability considerations:**

The scheme is expected to be used in the context of web applications.

**Security considerations:**

Any web page is able to register a handler for all "web+" schemes. As such, these schemes must not be used for features intended to be core platform features (e.g., HTTP). Similarly, such schemes must not store confidential information in their URLs, such as usernames, passwords, personal information, or confidential project names.

**Contact:**

Ian Hickson <ian@hixie.ch>

Change controller:

Ian Hickson <ian@hixie.ch>

References:

*Custom scheme handlers*, HTML Living Standard: <https://html.spec.whatwg.org/#custom-handlers>

## Index

The following sections only cover conforming elements and features.

### Elements

*This section is non-normative.*

| Element           | Description                                                       | Categories                                                                                                | Parents†                   | Children                                                                         | List of elements                                                                                                                                                                                                                                        | Attributes           |
|-------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <a href="#">a</a> | Hyperlink                                                         | <a href="#">flow</a> ; <a href="#">phrasing</a> *; <a href="#">interactive</a> ; <a href="#">palpable</a> | <a href="#">phrasing</a>   | <a href="#">transparent</a> *                                                    | <a href="#">globals</a> ; <a href="#">href</a> ; <a href="#">target</a> ; <a href="#">download</a> ; <a href="#">ping</a> ; <a href="#">rel</a> ; <a href="#">hreflang</a> ; <a href="#">type</a> ; <a href="#">referrerpolicy</a>                      | <a href="#">HTML</a> |
| <b>abbr</b>       | Abbreviation                                                      | <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                       | <a href="#">phrasing</a>   | <a href="#">phrasing</a>                                                         | <a href="#">globals</a>                                                                                                                                                                                                                                 | <a href="#">HTML</a> |
| <b>address</b>    | Contact information for a page or <a href="#">article</a> element | <a href="#">flow</a> ; <a href="#">palpable</a>                                                           | <a href="#">flow</a>       | <a href="#">flow</a> *                                                           | <a href="#">globals</a>                                                                                                                                                                                                                                 | <a href="#">HTML</a> |
| <b>area</b>       | Hyperlink or dead area on an image map                            | <a href="#">flow</a> ; <a href="#">phrasing</a>                                                           | <a href="#">phrasing</a> * | empty                                                                            | <a href="#">globals</a> ; <a href="#">alt</a> ; <a href="#">coords</a> ; <a href="#">shape</a> ; <a href="#">href</a> ; <a href="#">target</a> ; <a href="#">download</a> ; <a href="#">ping</a> ; <a href="#">rel</a> ; <a href="#">referrerpolicy</a> | <a href="#">HTML</a> |
| <b>article</b>    | Self-contained syndicatable or reusable composition               | <a href="#">flow</a> ; <a href="#">sectioning</a> ; <a href="#">palpable</a>                              | <a href="#">flow</a>       | <a href="#">flow</a>                                                             | <a href="#">globals</a>                                                                                                                                                                                                                                 | <a href="#">HTML</a> |
| <b>aside</b>      | Sidebar for tangentially related content                          | <a href="#">flow</a> ; <a href="#">sectioning</a> ; <a href="#">palpable</a>                              | <a href="#">flow</a>       | <a href="#">flow</a>                                                             | <a href="#">globals</a>                                                                                                                                                                                                                                 | <a href="#">HTML</a> |
| <b>audio</b>      | Audio player                                                      | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">embedded</a>                                | <a href="#">phrasing</a>   | <a href="#">source</a> *; <a href="#">track</a> *; <a href="#">transparent</a> * | <a href="#">globals</a> ; <a href="#">src</a> ; <a href="#">crossorigin</a> ; <a href="#">preload</a> ; <a href="#">autoplay</a> ; <a href="#">loop</a> ; <a href="#">muted</a>                                                                         | <a href="#">HTML</a> |

| Element           | Description                                                                    | Categories                                                                                         | Parents†        | Children          | Attributes                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>b</b>          | Keywords<br>Base URL<br>and default<br>target                                  | <u>interactive</u> ;<br><u>palpable</u> *<br><u>flow</u> ;<br><u>phrasing</u> ;<br><u>palpable</u> | <u>phrasing</u> | <u>phrasing</u>   | <u>controls</u><br><u>globals</u>                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>base</b>       | <u>browsing</u><br><u>context</u> for<br><u>hyperlinks</u><br>and <u>forms</u> | <u>metadata</u>                                                                                    | <u>head</u>     | empty             | <u>globals</u> ; <u>href</u> ; <u>target</u>                                                                                                                                                                                                                                                                                                                                                                             |
| <b>bdi</b>        | Text<br>directionality<br>isolation                                            | <u>flow</u> ;<br><u>phrasing</u> ;<br><u>palpable</u>                                              | <u>phrasing</u> | <u>phrasing</u>   | <u>globals</u>                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>bdo</b>        | Text<br>directionality<br>formatting                                           | <u>flow</u> ;<br><u>phrasing</u> ;<br><u>palpable</u>                                              | <u>phrasing</u> | <u>phrasing</u>   | <u>globals</u>                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>blockquote</b> | A section<br>quoted from<br>another<br>source                                  | <u>flow</u> ;<br><u>sectioning</u><br><u>root</u> ;<br><u>palpable</u>                             | <u>flow</u>     | <u>flow</u>       | <u>globals</u> ; <u>cite</u>                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>body</b>       | Document<br>body                                                               | <u>sectioning</u><br><u>root</u>                                                                   | <u>html</u>     | <u>flow</u>       | <u>globals</u> ; <u>onafterprint</u> ;<br><u>onbeforeprint</u> ;<br><u>onbeforeunload</u> ;<br><u>onhashchange</u> ;<br><u>onlanguagechange</u> ;<br><u>onmessage</u> ;<br><u>onmessageerror</u> ;<br><u>onoffline</u> ; <u>ononline</u> ;<br><u>onpagehide</u> ;<br><u>onpageshow</u> ;<br><u>onpopstate</u> ;<br><u>onrejectionhandled</u> ;<br><u>onstorage</u> ;<br><u>onunhandledrejection</u> ;<br><u>onunload</u> |
| <b>br</b>         | Line break,<br>e.g. in poem<br>or postal<br>address                            | <u>flow</u> ;<br><u>phrasing</u>                                                                   | <u>phrasing</u> | empty             | <u>globals</u>                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>button</b>     | Button<br>control                                                              | <u>flow</u> ;<br><u>phrasing</u> ;<br><u>interactive</u> ;                                         | <u>phrasing</u> | <u>phrasing</u> * | <u>globals</u> ; <u>disabled</u> ; <u>form</u> ;<br><u>formaction</u> ;<br><u>formenctype</u> ;                                                                                                                                                                                                                                                                                                                          |

| Element                  | Description                                                 | Categories                                                                                                                                    | Parents†                                   | Children                                                                                           | Attributes                                                                                                                                                     |
|--------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">form</a>     | Scriptable bitmap canvas                                    | <a href="#">listed</a> ; <a href="#">labelable</a> ; <a href="#">submittable</a> ; <a href="#">form-associated</a> ; <a href="#">palpable</a> |                                            |                                                                                                    | <a href="#">formmethod</a> ; <a href="#">formnovalidate</a> ; <a href="#">formtarget</a> ; <a href="#">name</a> ; <a href="#">type</a> ; <a href="#">value</a> |
| <a href="#">caption</a>  | Table caption                                               | none                                                                                                                                          | <a href="#">table</a>                      | <a href="#">flow</a> *                                                                             | <a href="#">globals</a>                                                                                                                                        |
| <a href="#">cite</a>     | Title of a work                                             | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                    | <a href="#">phrasing</a>                   | <a href="#">phrasing</a>                                                                           | <a href="#">globals</a>                                                                                                                                        |
| <a href="#">code</a>     | Computer code                                               | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                    | <a href="#">phrasing</a>                   | <a href="#">phrasing</a>                                                                           | <a href="#">globals</a>                                                                                                                                        |
| <a href="#">col</a>      | Table column                                                | none                                                                                                                                          | <a href="#">colgroup</a>                   | <a href="#">empty</a>                                                                              | <a href="#">globals</a> ; <a href="#">span</a>                                                                                                                 |
| <a href="#">colgroup</a> | Group of columns in a table                                 | none                                                                                                                                          | <a href="#">table</a>                      | <a href="#">col</a> *; <a href="#">template</a> *                                                  | <a href="#">globals</a> ; <a href="#">span</a>                                                                                                                 |
| <a href="#">data</a>     | Machine-readable equivalent                                 | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                    | <a href="#">phrasing</a>                   | <a href="#">phrasing</a>                                                                           | <a href="#">globals</a> ; <a href="#">value</a>                                                                                                                |
| <a href="#">datalist</a> | Container for options for <a href="#">combo box</a> control | <a href="#">flow</a> ; <a href="#">phrasing</a>                                                                                               | <a href="#">phrasing</a>                   | <a href="#">phrasing</a> *; <a href="#">option</a> *; <a href="#">script-supporting elements</a> * | <a href="#">globals</a>                                                                                                                                        |
| <a href="#">dd</a>       | Content for corresponding <a href="#">dt</a> element(s)     | none                                                                                                                                          | <a href="#">dl</a> ; <a href="#">div</a> * | <a href="#">flow</a>                                                                               | <a href="#">globals</a>                                                                                                                                        |
| <a href="#">del</a>      | A removal from the document                                 | <a href="#">flow</a> ; <a href="#">phrasing</a> *                                                                                             | <a href="#">phrasing</a>                   | <a href="#">transparent</a>                                                                        | <a href="#">globals</a> ; <a href="#">cite</a> ; <a href="#">datetime</a>                                                                                      |
| <a href="#">details</a>  | Disclosure control for hiding details                       | <a href="#">flow</a> ; <a href="#">sectioning root</a> ; <a href="#">interactive</a> ; <a href="#">palpable</a>                               | <a href="#">flow</a>                       | <a href="#">summary</a> *; <a href="#">flow</a>                                                    | <a href="#">globals</a> ; <a href="#">open</a>                                                                                                                 |
| <a href="#">dfn</a>      | Defining instance                                           | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                    | <a href="#">phrasing</a>                   | <a href="#">phrasing</a> *                                                                         | <a href="#">globals</a>                                                                                                                                        |
| <a href="#">dialog</a>   | Dialog box or                                               | <a href="#">flow</a>                                                                                                                          | <a href="#">flow</a>                       | <a href="#">flow</a>                                                                               | <a href="#">globals</a> ; <a href="#">open</a>                                                                                                                 |

| Element                           | Description                                                                      | Categories                                                                             | Parents†                 | Children                                                                  | Attributes                                                                                                                                                      |
|-----------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   | window                                                                           | <u>sectioning root</u>                                                                 |                          |                                                                           |                                                                                                                                                                 |
| <b>div</b>                        | Generic flow container, or container for name-value groups in <b>dl</b> elements | <u>flow</u> ; <u>palpable</u>                                                          | <u>flow</u> ; <b>dl</b>  | <u>flow</u>                                                               | <u>globals</u>                                                                                                                                                  |
| <b>dl</b>                         | Association list consisting of zero or more name-value groups                    | <u>flow</u> ; <u>palpable</u>                                                          | <u>flow</u>              | <u>dt*</u> ; <u>dd*</u> ; <u>div*</u> ; <u>script-supporting elements</u> | <u>globals</u>                                                                                                                                                  |
| <b>dt</b>                         | Legend for corresponding <u>dd</u> element(s)                                    | none                                                                                   | <b>dl</b> ; <b>div</b> * | <u>flow</u> *                                                             | <u>globals</u>                                                                                                                                                  |
| <b>em</b>                         | Stress emphasis                                                                  | <u>flow</u> ; <u>phrasing</u> ; <u>palpable</u>                                        | <u>flow</u>              | <u>phrasing</u>                                                           | <u>globals</u>                                                                                                                                                  |
| <b>embed</b>                      | Plugin                                                                           | <u>flow</u> ; <u>phrasing</u> ; <u>embedded</u> ; <u>interactive</u> ; <u>palpable</u> | <u>phrasing</u>          | empty                                                                     | <u>globals</u> ; <u>src</u> ; <u>type</u> ; <u>width</u> ; <u>height</u> ; any*                                                                                 |
| <b>fieldset</b>                   | Group of form controls                                                           | <u>root</u> ; <u>listed</u> ; <u>form-associated</u> ; <u>palpable</u>                 | <u>flow</u>              | <u>legend</u> *; <u>flow</u>                                              | <u>globals</u> ; <u>disabled</u> ; <u>form</u> ; <u>name</u>                                                                                                    |
| <b>figcaption</b>                 | Caption for <b>figure</b>                                                        | none                                                                                   | <b>figure</b>            | <u>flow</u>                                                               | <u>globals</u>                                                                                                                                                  |
| <b>figure</b>                     | Figure with optional caption                                                     | <u>flow</u> ; <u>sectioning root</u> ; <u>palpable</u>                                 | <u>flow</u>              | <u>figcaption</u> *; <u>flow</u>                                          | <u>globals</u>                                                                                                                                                  |
| <b>footer</b>                     | Footer for a page or section                                                     | <u>flow</u> ; <u>palpable</u>                                                          | <u>flow</u>              | <u>flow</u> *                                                             | <u>globals</u>                                                                                                                                                  |
| <b>form</b>                       | User-submittable form                                                            | <u>flow</u> ; <u>palpable</u>                                                          | <u>flow</u>              | <u>flow</u> *                                                             | <u>globals</u> ; <u>accept-charset</u> ; <u>action</u> ; <u>autocomplete</u> ; <u>enctype</u> ; <u>method</u> ; <u>name</u> ; <u>novalidate</u> ; <u>target</u> |
| <b>h1</b> , <b>h2</b> , <b>h3</b> | Section                                                                          | <u>flow</u>                                                                            | <u>legend</u>            | <u>phrasing</u>                                                           | <u>globals</u>                                                                                                                                                  |

| Element                                                      | Description                                             | Categories                                                                                                                                                                                                                                                    | Parents†                                                                | Children                                                                                                                                                                 | Attributes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">h4</a> , <a href="#">h5</a> , <a href="#">h6</a> | heading                                                 | <a href="#">heading</a> ; <a href="#">palpable</a>                                                                                                                                                                                                            | <a href="#">summary</a> ; <a href="#">flow</a>                          |                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <a href="#">head</a>                                         | Container for document metadata                         | none                                                                                                                                                                                                                                                          | <a href="#">html</a>                                                    | <a href="#">metadata</a><br><a href="#">content</a> *                                                                                                                    | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <a href="#">header</a>                                       | Introductory or navigational aids for a page or section | <a href="#">flow</a> ; <a href="#">palpable</a>                                                                                                                                                                                                               | <a href="#">flow</a>                                                    | <a href="#">flow</a> *                                                                                                                                                   | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <a href="#">hgroup</a>                                       | heading group                                           | <a href="#">flow</a> ; <a href="#">heading</a> ; <a href="#">palpable</a>                                                                                                                                                                                     | <a href="#">legend</a> ; <a href="#">summary</a> ; <a href="#">flow</a> | <a href="#">h1</a> ; <a href="#">h2</a> ; <a href="#">h3</a> ; <a href="#">h4</a> ; <a href="#">h5</a> ; <a href="#">h6</a> ; <a href="#">script-supporting elements</a> | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <a href="#">hr</a>                                           | Thematic break                                          | <a href="#">flow</a>                                                                                                                                                                                                                                          | <a href="#">flow</a>                                                    | empty                                                                                                                                                                    | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <a href="#">html</a>                                         | Root element                                            | none                                                                                                                                                                                                                                                          | none*                                                                   | <a href="#">head</a> *; <a href="#">body</a> *                                                                                                                           | <a href="#">globals</a> ; <a href="#">manifest</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <a href="#">i</a>                                            | Alternate voice                                         | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                                                                                                                                    | <a href="#">phrasing</a>                                                | <a href="#">phrasing</a>                                                                                                                                                 | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <a href="#">iframe</a>                                       | Nested browsing context                                 | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">embedded</a> ; <a href="#">phrasing</a> ; <a href="#">interactive</a> ; <a href="#">palpable</a>                                                                                                | <a href="#">phrasing</a>                                                | empty                                                                                                                                                                    | <a href="#">globals</a> ; <a href="#">src</a> ; <a href="#">srcdoc</a> ; <a href="#">name</a> ; <a href="#">sandbox</a> ; <a href="#">allow</a> ; <a href="#">allowfullscreen</a> ; <a href="#">width</a> ; <a href="#">height</a> ; <a href="#">referrerpolicy</a> ; <a href="#">loading</a>                                                                                                                                                                                                                          |
| <a href="#">img</a>                                          | Image                                                   | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">embedded</a> ; <a href="#">interactive</a> *; <a href="#">phrasing</a> ; <a href="#">picture</a><br><a href="#">form-associated</a> ; <a href="#">palpable</a>                                  | <a href="#">phrasing</a> ; <a href="#">picture</a>                      | empty                                                                                                                                                                    | <a href="#">globals</a> ; <a href="#">alt</a> ; <a href="#">src</a> ; <a href="#">srcset</a> ; <a href="#">sizes</a> ; <a href="#">crossorigin</a> ; <a href="#">usemap</a> ; <a href="#">ismap</a> ; <a href="#">width</a> ; <a href="#">height</a> ; <a href="#">referrerpolicy</a> ; <a href="#">decoding</a> ; <a href="#">loading</a>                                                                                                                                                                             |
| <a href="#">input</a>                                        | Form control                                            | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">interactive</a> *; <a href="#">listed</a> ; <a href="#">labelable</a> ; <a href="#">submittable</a> ; <a href="#">resettable</a> ; <a href="#">form-associated</a> ; <a href="#">palpable</a> * | <a href="#">phrasing</a>                                                | empty                                                                                                                                                                    | <a href="#">globals</a> ; <a href="#">accept</a> ; <a href="#">alt</a> ; <a href="#">autocomplete</a> ; <a href="#">checked</a> ; <a href="#">dirname</a> ; <a href="#">disabled</a> ; <a href="#">form</a> ; <a href="#">formaction</a> ; <a href="#">formenctype</a> ; <a href="#">formmethod</a> ; <a href="#">formnovalidate</a> ; <a href="#">formtarget</a> ; <a href="#">height</a> ; <a href="#">list</a> ; <a href="#">max</a> ; <a href="#">maxlength</a> ; <a href="#">min</a> ; <a href="#"> minlength</a> |

| Element       | Description                                         | Categories                                                                        | Parents†                                                         | Children                                                        | Attributes                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------|-----------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ins</b>    | An addition to the document                         | <a href="#">flow</a> ; <a href="#">phrasing</a> *; <a href="#">palpable</a>       | <a href="#">phrasing</a>                                         | <a href="#">transparent</a>                                     | <a href="#">multiple</a> ; <a href="#">name</a> ; <a href="#">pattern</a> ; <a href="#">placeholder</a> ; <a href="#">readonly</a> ; <a href="#">required</a> ; <a href="#">size</a> ; <a href="#">src</a> ; <a href="#">step</a> ; <a href="#">type</a> ; <a href="#">value</a> ; <a href="#">width</a>                                                                                             |
| <b>kbd</b>    | User input                                          | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>        | <a href="#">phrasing</a>                                         | <a href="#">phrasing</a>                                        | <a href="#">globals</a> ; <a href="#">cite</a> ; <a href="#">datetime</a>                                                                                                                                                                                                                                                                                                                            |
| <b>label</b>  | Caption for a form control                          | <a href="#">phrasing</a> ; <a href="#">interactive</a> ; <a href="#">palpable</a> | <a href="#">phrasing</a>                                         | <a href="#">phrasing</a> *                                      | <a href="#">globals</a> ; <a href="#">for</a>                                                                                                                                                                                                                                                                                                                                                        |
| <b>legend</b> | Caption for <a href="#">fieldset</a>                | none                                                                              | <a href="#">fieldset</a>                                         | <a href="#">phrasing</a> ; <a href="#">heading content</a>      | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                              |
| <b>li</b>     | List item                                           | none                                                                              | <a href="#">ol</a> ; <a href="#">ul</a> ; <a href="#">menu</a> * | <a href="#">flow</a>                                            | <a href="#">globals</a> ; <a href="#">value</a> *                                                                                                                                                                                                                                                                                                                                                    |
| <b>link</b>   | Link metadata                                       | <a href="#">metadata</a> ; <a href="#">flow</a> *; <a href="#">phrasing</a> *     | <a href="#">head</a> ; <a href="#">noscript</a> *; empty         | <a href="#">phrasing</a> *                                      | <a href="#">globals</a> ; <a href="#">href</a> ; <a href="#">crossorigin</a> ; <a href="#">rel</a> ; <a href="#">as</a> ; <a href="#">media</a> ; <a href="#">hreflang</a> ; <a href="#">type</a> ; <a href="#">sizes</a> ; <a href="#">imagesrcset</a> ; <a href="#">imagesizes</a> ; <a href="#">referrerpolicy</a> ; <a href="#">integrity</a> ; <a href="#">color</a> ; <a href="#">disabled</a> |
| <b>main</b>   | Container for the dominant contents of the document | <a href="#">flow</a> ; <a href="#">palpable</a>                                   | <a href="#">flow</a> *                                           | <a href="#">flow</a>                                            | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                              |
| <b>map</b>    | Image map                                           | <a href="#">flow</a> ; <a href="#">phrasing</a> *; <a href="#">palpable</a>       | <a href="#">phrasing</a>                                         | <a href="#">transparent</a> ; <a href="#">area</a> *            | <a href="#">globals</a> ; <a href="#">name</a>                                                                                                                                                                                                                                                                                                                                                       |
| <b>mark</b>   | Highlight                                           | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>        | <a href="#">phrasing</a>                                         | <a href="#">phrasing</a>                                        | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                              |
| <b>math</b>   | MathML root                                         | <a href="#">phrasing</a> ; <a href="#">embedded</a> ; <a href="#">palpable</a>    | <a href="#">phrasing</a>                                         | per <a href="#">[MATHML]</a> per <a href="#">[MATHML]</a>       | <a href="#">Element</a>                                                                                                                                                                                                                                                                                                                                                                              |
| <b>menu</b>   | Menu of commands                                    | <a href="#">flow</a> ; <a href="#">palpable</a> *                                 | <a href="#">flow</a>                                             | <a href="#">li</a> ; <a href="#">script-supporting elements</a> | <a href="#">globals</a>                                                                                                                                                                                                                                                                                                                                                                              |

| Element                  | Description                               | Categories                                                                                                                                                                                     | Parents†                                                                               | Children                                                                   | Attributes                                                                                                                                                           |
|--------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">meta</a>     | Text metadata                             | <a href="#">metadata</a> ; <a href="#">flow</a> *; <a href="#">phrasing</a> *<br><a href="#">flow</a> ; <a href="#">phrasing</a>                                                               | <a href="#">head</a> ; <a href="#">noscript</a> *; empty<br><a href="#">phrasing</a> * |                                                                            | <a href="#">globals</a> ; <a href="#">name</a> ; <a href="#">http-equiv</a> ; <a href="#">content</a> ; <a href="#">charset</a> ; <a href="#">media</a>              |
| <a href="#">meter</a>    | Gauge                                     | <a href="#">phrasing</a> ; <a href="#">labelable</a> ; <a href="#">palpable</a>                                                                                                                | <a href="#">phrasing</a>                                                               | <a href="#">phrasing</a> *                                                 | <a href="#">globals</a> ; <a href="#">value</a> ; <a href="#">min</a> ; <a href="#">max</a> ; <a href="#">low</a> ; <a href="#">high</a> ; <a href="#">optimum</a>   |
| <a href="#">nav</a>      | Section with navigational links           | <a href="#">flow</a> ; <a href="#">sectioning</a> ; <a href="#">palpable</a>                                                                                                                   | <a href="#">flow</a>                                                                   | <a href="#">flow</a>                                                       | <a href="#">globals</a>                                                                                                                                              |
| <a href="#">noscript</a> | Fallback content for script               | <a href="#">metadata</a> ; <a href="#">flow</a> ; <a href="#">phrasing</a><br><a href="#">flow</a> ; <a href="#">phrasing</a>                                                                  | <a href="#">head</a> *; <a href="#">phrasing</a> *                                     | varies*                                                                    | <a href="#">globals</a>                                                                                                                                              |
| <a href="#">object</a>   | Image, nested browsing context, or plugin | <a href="#">phrasing</a> ; <a href="#">embedded</a> ; <a href="#">interactive</a> *; <a href="#">phrasing</a> listed; <a href="#">form-associated</a> ; <a href="#">palpable</a>               |                                                                                        | <a href="#">param</a> *; <a href="#">transparent</a>                       | <a href="#">globals</a> ; <a href="#">data</a> ; <a href="#">type</a> ; <a href="#">name</a> ; <a href="#">form</a> ; <a href="#">width</a> ; <a href="#">height</a> |
| <a href="#">ol</a>       | Ordered list                              | <a href="#">flow</a> ; <a href="#">palpable</a> *                                                                                                                                              | <a href="#">flow</a>                                                                   | <a href="#">li</a> ; <a href="#">script-supporting elements</a>            | <a href="#">globals</a> ; <a href="#">reversed</a> ; <a href="#">start</a> ; <a href="#">type</a>                                                                    |
| <a href="#">optgroup</a> | Group of options in a list box            | none                                                                                                                                                                                           | <a href="#">select</a>                                                                 | <a href="#">option</a> ; <a href="#">script-supporting elements</a>        | <a href="#">globals</a> ; <a href="#">disabled</a> ; <a href="#">label</a>                                                                                           |
| <a href="#">option</a>   | Option in a list box or combo box control | none                                                                                                                                                                                           | <a href="#">select</a> ; <a href="#">datalist</a> ; <a href="#">text</a> *             | <a href="#">optgroup</a>                                                   | <a href="#">globals</a> ; <a href="#">disabled</a> ; <a href="#">label</a> ; <a href="#">selected</a> ; <a href="#">value</a>                                        |
| <a href="#">output</a>   | Calculated output value                   | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">listed</a> ; <a href="#">labelable</a> ; <a href="#">resettable</a> ; <a href="#">form-associated</a> ; <a href="#">palpable</a> | <a href="#">phrasing</a>                                                               | <a href="#">phrasing</a>                                                   | <a href="#">globals</a> ; <a href="#">for</a> ; <a href="#">form</a> ; <a href="#">name</a>                                                                          |
| <a href="#">p</a>        | Paragraph                                 | <a href="#">flow</a> ; <a href="#">palpable</a>                                                                                                                                                | <a href="#">flow</a>                                                                   | <a href="#">phrasing</a>                                                   | <a href="#">globals</a>                                                                                                                                              |
| <a href="#">param</a>    | Parameter for <a href="#">object</a>      | none                                                                                                                                                                                           | <a href="#">object</a>                                                                 | empty                                                                      | <a href="#">globals</a> ; <a href="#">name</a> ; <a href="#">value</a>                                                                                               |
| <a href="#">picture</a>  | Image                                     | <a href="#">flow</a> ; <a href="#">phrasing</a>                                                                                                                                                | <a href="#">phrasing</a>                                                               | <a href="#">source</a> *; one <a href="#">img</a> ; <a href="#">script</a> | <a href="#">globals</a>                                                                                                                                              |

| Element                  | Description                             | Categories                                                                                                                                                                                                                      | Parents†                                                                            | Children                                                                              | Attributes                                                                                                                                                                                                      |
|--------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">pre</a>      | Block of preformatted text              | <a href="#">embedded</a>                                                                                                                                                                                                        | <a href="#">flow</a>                                                                | <a href="#">phrasing</a>                                                              | <a href="#">globals</a>                                                                                                                                                                                         |
| <a href="#">progress</a> | Progress bar                            | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">labelable</a> ; <a href="#">palpable</a>                                                                                                                          | <a href="#">phrasing</a>                                                            | <a href="#">phrasing</a> *                                                            | <a href="#">globals</a> ; <a href="#">value</a> ; <a href="#">max</a>                                                                                                                                           |
| <a href="#">q</a>        | Quotation                               | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                                                                                                      | <a href="#">phrasing</a>                                                            | <a href="#">phrasing</a>                                                              | <a href="#">globals</a> ; <a href="#">cite</a>                                                                                                                                                                  |
| <a href="#">rp</a>       | Parenthesis for ruby annotation text    | none                                                                                                                                                                                                                            | <a href="#">ruby</a>                                                                | <a href="#">text</a>                                                                  | <a href="#">globals</a>                                                                                                                                                                                         |
| <a href="#">rt</a>       | Ruby annotation text                    | none                                                                                                                                                                                                                            | <a href="#">ruby</a>                                                                | <a href="#">phrasing</a>                                                              | <a href="#">globals</a>                                                                                                                                                                                         |
| <a href="#">ruby</a>     | Ruby annotation(s)                      | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                                                                                                      | <a href="#">phrasing</a>                                                            | <a href="#">phrasing</a> ; <a href="#">rt</a> ; <a href="#">rp</a> *                  | <a href="#">globals</a>                                                                                                                                                                                         |
| <a href="#">s</a>        | Inaccurate text                         | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                                                                                                      | <a href="#">phrasing</a>                                                            | <a href="#">phrasing</a>                                                              | <a href="#">globals</a>                                                                                                                                                                                         |
| <a href="#">samp</a>     | Computer output                         | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                                                                                                                      | <a href="#">phrasing</a>                                                            | <a href="#">phrasing</a>                                                              | <a href="#">globals</a>                                                                                                                                                                                         |
| <a href="#">script</a>   | Embedded script                         | <a href="#">metadata</a> ; <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">script-supporting</a>                                                                                                                  | <a href="#">head</a> ; <a href="#">phrasing</a> ; <a href="#">script-supporting</a> | script, data, or script documentation*                                                | <a href="#">globals</a> ; <a href="#">src</a> ; <a href="#">type</a> ; <a href="#">async</a> ; <a href="#">defer</a> ; <a href="#">crossorigin</a> ; <a href="#">integrity</a> ; <a href="#">referrerpolicy</a> |
| <a href="#">section</a>  | Generic document or application section | <a href="#">flow</a> ; <a href="#">sectioning</a> ; <a href="#">palpable</a>                                                                                                                                                    | <a href="#">flow</a>                                                                | <a href="#">flow</a>                                                                  | <a href="#">globals</a>                                                                                                                                                                                         |
| <a href="#">select</a>   | List box control                        | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">interactive</a> ; <a href="#">listed</a> ; <a href="#">labelable</a> ; <a href="#">submittable</a> ; <a href="#">resettable</a> ; <a href="#">form-supporting</a> | <a href="#">phrasing</a>                                                            | <a href="#">option</a> ; <a href="#">optgroup</a> ; <a href="#">script-supporting</a> | <a href="#">globals</a> ; <a href="#">autocomplete</a> ; <a href="#">disabled</a> ; <a href="#">form</a> ; <a href="#">multiple</a> ; <a href="#">name</a> ; <a href="#">required</a> ; <a href="#">size</a>    |

| Element                                 | Description                                                                                             | Categories                                                                                               | Parents†                                                                | Children                                                                                                                                                                                           | Attributes                                                                                                                                                                                     |                      |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <a href="#">slot</a>                    | Shadow tree slot                                                                                        | <a href="#">associated</a> ; <a href="#">palpable</a><br><a href="#">flow</a> ; <a href="#">phrasing</a> | <a href="#">phrasing</a>                                                | <a href="#">transparent</a>                                                                                                                                                                        | <a href="#">globals</a> ; <a href="#">name</a>                                                                                                                                                 | <a href="#">HTML</a> |
| <a href="#">small</a>                   | Side comment                                                                                            | <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                      | <a href="#">phrasing</a>                                                | <a href="#">phrasing</a>                                                                                                                                                                           | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |
| <a href="#">source</a>                  | Image source for <a href="#">img</a> or media source for <a href="#">video</a> or <a href="#">audio</a> | <a href="#">none</a>                                                                                     | <a href="#">picture</a> ; <a href="#">video</a> ; <a href="#">audio</a> | <a href="#">empty</a>                                                                                                                                                                              | <a href="#">globals</a> ; <a href="#">src</a> ; <a href="#">type</a> ; <a href="#">srcset</a> ; <a href="#">sizes</a> ; <a href="#">media</a> ; <a href="#">width</a> ; <a href="#">height</a> | <a href="#">HTML</a> |
| <a href="#">span</a>                    | Generic phrasing container                                                                              | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                               | <a href="#">phrasing</a>                                                | <a href="#">phrasing</a>                                                                                                                                                                           | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |
| <a href="#">strong</a>                  | Importance                                                                                              | <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                      | <a href="#">phrasing</a>                                                | <a href="#">phrasing</a>                                                                                                                                                                           | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |
| <a href="#">style</a>                   | Embedded styling information                                                                            | <a href="#">metadata</a>                                                                                 | <a href="#">head</a> ; <a href="#">noscript</a> *                       | <a href="#">text</a> *                                                                                                                                                                             | <a href="#">globals</a> ; <a href="#">media</a>                                                                                                                                                | <a href="#">HTML</a> |
| <a href="#">sub</a>                     | Subscript                                                                                               | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                               | <a href="#">phrasing</a>                                                | <a href="#">phrasing</a>                                                                                                                                                                           | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |
| <a href="#">summary</a>                 | Caption for <a href="#">details</a>                                                                     | <a href="#">none</a>                                                                                     | <a href="#">details</a>                                                 | <a href="#">phrasing</a> ; <a href="#">heading content</a>                                                                                                                                         | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |
| <a href="#">sup</a>                     | Superscript                                                                                             | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                               | <a href="#">phrasing</a>                                                | <a href="#">phrasing</a>                                                                                                                                                                           | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |
| <a href="#">SVG</a> <a href="#">svg</a> | SVG root                                                                                                | <a href="#">phrasing</a> ; <a href="#">embedded</a> ; <a href="#">palpable</a>                           | <a href="#">phrasing</a>                                                | per <a href="#">[SVG]</a>                                                                                                                                                                          | per <a href="#">[SVG]</a>                                                                                                                                                                      | <a href="#">SVG</a>  |
| <a href="#">table</a>                   | Table                                                                                                   | <a href="#">flow</a> ; <a href="#">palpable</a>                                                          | <a href="#">flow</a>                                                    | <a href="#">caption</a> *; <a href="#">colgroup</a> *; <a href="#">thead</a> *; <a href="#">tbody</a> *; <a href="#">tfoot</a> *; <a href="#">tr</a> *; <a href="#">script-supporting elements</a> | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |
| <a href="#">tbody</a>                   | Group of rows in a table                                                                                | <a href="#">none</a>                                                                                     | <a href="#">table</a>                                                   | <a href="#">tr</a> ; <a href="#">script-supporting elements</a>                                                                                                                                    | <a href="#">globals</a>                                                                                                                                                                        | <a href="#">HTML</a> |

| Element                  | Description                                               | Categories                                                                                                                                                            | Parents†                                   | Children                                            | Attributes                                                                                                                      |
|--------------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">td</a>       | Table cell                                                | <a href="#">sectioning root</a><br><a href="#">metadata; flow</a><br><a href="#">phrasing; interactive; listed;</a>                                                   | <a href="#">tr</a>                         | <a href="#">flow</a>                                | <a href="#">globals; colspan; rowspan; headers</a>                                                                              |
| <a href="#">template</a> | Template                                                  | <a href="#">phrasing; script-supporting</a><br><a href="#">script-supporting</a><br><a href="#">colgroup*</a><br><a href="#">flow; phrasing; interactive; listed;</a> | <a href="#">script-supporting</a>          | empty                                               | <a href="#">globals</a>                                                                                                         |
| <a href="#">textarea</a> | Multiline text controls                                   | <a href="#">labelable; submittable; resettable; form-associated; palpable</a>                                                                                         | <a href="#">phrasing</a>                   | <a href="#">text</a>                                | <a href="#">globals; cols; dirname; disabled; form; maxlength; minlength; name; placeholder; readonly; required; rows; wrap</a> |
| <a href="#">tfoot</a>    | Group of footer rows in none a table                      |                                                                                                                                                                       | <a href="#">table</a>                      | <a href="#">tr; script-supporting elements</a>      | <a href="#">globals</a>                                                                                                         |
| <a href="#">th</a>       | Table header cell                                         | <a href="#">interactive*</a>                                                                                                                                          | <a href="#">tr</a>                         | <a href="#">flow*</a>                               | <a href="#">globals; colspan; rowspan; headers; scope; abbr</a>                                                                 |
| <a href="#">thead</a>    | Group of heading rows none in a table                     |                                                                                                                                                                       | <a href="#">table</a>                      | <a href="#">tr; script-supporting elements</a>      | <a href="#">globals</a>                                                                                                         |
| <a href="#">time</a>     | Machine-readable equivalent of date- or time-related data | <a href="#">flow; phrasing; palpable</a>                                                                                                                              | <a href="#">phrasing</a>                   | <a href="#">phrasing</a>                            | <a href="#">globals; datetime</a>                                                                                               |
| <a href="#">title</a>    | Document title                                            | <a href="#">metadata</a>                                                                                                                                              | <a href="#">head</a>                       | <a href="#">text*</a>                               | <a href="#">globals</a>                                                                                                         |
| <a href="#">tr</a>       | Table row                                                 | none                                                                                                                                                                  | <a href="#">table; thead; tbody; tfoot</a> | <a href="#">th*; td; script-supporting elements</a> | <a href="#">globals</a>                                                                                                         |
| <a href="#">track</a>    | Timed text track                                          | none                                                                                                                                                                  | <a href="#">audio; video</a>               | empty                                               | <a href="#">globals; default; kind; label; src; srclang</a>                                                                     |
| <a href="#">u</a>        | Unarticulated annotation                                  | <a href="#">flow; phrasing; palpable</a>                                                                                                                              | <a href="#">phrasing</a>                   | <a href="#">phrasing</a>                            | <a href="#">globals</a>                                                                                                         |
| <a href="#">ul</a>       | List                                                      | <a href="#">flow; palpable*</a>                                                                                                                                       | <a href="#">flow</a>                       | <a href="#">li; script-supporting</a>               | <a href="#">globals</a>                                                                                                         |

| Element                                    | Description               | Categories                                                                                                                          | Parents†                                        | Children                                                                        | Attributes                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">var</a>                        | Variable                  | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                          | <a href="#">phrasing</a>                        | <a href="#">phrasing</a>                                                        | <a href="#">globals</a>                                                                                                                                                                                                                                                                                            |
| <a href="#">video</a>                      | Video player              | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">embedded</a> ; <a href="#">interactive</a> ; <a href="#">palpable</a> | <a href="#">phrasing</a>                        | <a href="#">source*</a> ; <a href="#">track*</a> ; <a href="#">transparent*</a> | <a href="#">globals</a> ; <a href="#">src</a> ; <a href="#">crossorigin</a> ; <a href="#">poster</a> ; <a href="#">preload</a> ; <a href="#">autoplay</a> ; <a href="#">playsinline</a> ; <a href="#">loop</a> ; <a href="#">muted</a> ; <a href="#">controls</a> ; <a href="#">width</a> ; <a href="#">height</a> |
| <a href="#">wbr</a>                        | Line breaking opportunity | <a href="#">flow</a> ; <a href="#">phrasing</a>                                                                                     | <a href="#">phrasing</a>                        | empty                                                                           | <a href="#">globals</a>                                                                                                                                                                                                                                                                                            |
| <a href="#">autonomous custom elements</a> | Author-defined elements   | <a href="#">flow</a> ; <a href="#">phrasing</a> ; <a href="#">palpable</a>                                                          | <a href="#">flow</a> ; <a href="#">phrasing</a> | <a href="#">transparent</a>                                                     | <a href="#">globals</a> ; any, as decided by the element's author                                                                                                                                                                                                                                                  |

An asterisk (\*) in a cell indicates that the actual rules are more complicated than indicated in the table above.

† Categories in the "Parents" column refer to parents that list the given categories in their content model, not to elements that themselves are in those categories. For example, the [a](#) element's "Parents" column says "phrasing", so any element whose content model contains the "phrasing" category could be a parent of an [a](#) element. Since the "flow" category includes all the "phrasing" elements, that means the [th](#) element could be a parent to an [a](#) element.

## Element content categories

*This section is non-normative.*

| List of element content categories |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                          |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Category                           | Elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Elements with exceptions                                                                                                                                                                                                                                                                                                 |
| <a href="#">Metadata content</a>   | <a href="#">base</a> ; <a href="#">link</a> ; <a href="#">meta</a> ; <a href="#">noscript</a> ; <a href="#">script</a> ; <a href="#">style</a> ; <a href="#">template</a> ; <a href="#">title</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | —                                                                                                                                                                                                                                                                                                                        |
| <a href="#">Flow content</a>       | <a href="#">a</a> ; <a href="#">abbr</a> ; <a href="#">address</a> ; <a href="#">article</a> ; <a href="#">aside</a> ; <a href="#">audio</a> ; <a href="#">b</a> ; <a href="#">bdi</a> ; <a href="#">bdo</a> ; <a href="#">blockquote</a> ; <a href="#">br</a> ; <a href="#">button</a> ; <a href="#">canvas</a> ; <a href="#">cite</a> ; <a href="#">code</a> ; <a href="#">data</a> ; <a href="#">datalist</a> ; <a href="#">del</a> ; <a href="#">details</a> ; <a href="#">dfn</a> ; <a href="#">dialog</a> ; <a href="#">div</a> ; <a href="#">dl</a> ; <a href="#">em</a> ; <a href="#">embed</a> ; <a href="#">fieldset</a> ; <a href="#">figure</a> ; <a href="#">footer</a> ; <a href="#">form</a> ; <a href="#">h1</a> ; <a href="#">h2</a> ; <a href="#">h3</a> ; <a href="#">h4</a> ; <a href="#">h5</a> ; <a href="#">h6</a> ; <a href="#">header</a> ; <a href="#">hgroup</a> ; <a href="#">hr</a> ; <a href="#">i</a> ; <a href="#">iframe</a> ; <a href="#">img</a> ; <a href="#">input</a> ; <a href="#">ins</a> ; <a href="#">kbd</a> ; <a href="#">label</a> ; <a href="#">map</a> ; <a href="#">mark</a> ; <a href="#">MathML math</a> ; <a href="#">menu</a> ; <a href="#">meter</a> ; <a href="#">nav</a> ; <a href="#">noscript</a> ; <a href="#">object</a> ; <a href="#">ol</a> ; <a href="#">output</a> ; <a href="#">p</a> ; <a href="#">picture</a> ; <a href="#">pre</a> ; <a href="#">progress</a> ; <a href="#">q</a> ; <a href="#">ruby</a> ; <a href="#">s</a> ; <a href="#">samp</a> ; <a href="#">script</a> ; <a href="#">section</a> ; <a href="#">select</a> ; <a href="#">slot</a> ; <a href="#">small</a> ; <a href="#">span</a> ; <a href="#">strong</a> ; <a href="#">sub</a> ; <a href="#">sup</a> ; <a href="#">SVG svg</a> ; <a href="#">table</a> ; <a href="#">template</a> ; <a href="#">textarea</a> ; <a href="#">time</a> ; <a href="#">u</a> ; <a href="#">ul</a> ; <a href="#">var</a> ; | <a href="#">area</a> (if it is a descendant of a <a href="#">map</a> element); <a href="#">link</a> (if it is <a href="#">allowed in the body</a> ); <a href="#">main</a> (if it is a <a href="#">hierarchically correct main element</a> ); <a href="#">meta</a> (if the <a href="#">itemprop</a> attribute is present) |

| Category                                  | Elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Elements with exceptions                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>Sectioning content</u>                 | <u>video</u> ; <u>wbr</u> ; autonomous custom elements; Text                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | —                                                                                                                                                                                                                                                                                                                 |
| <u>Heading content</u>                    | <u>article</u> ; <u>aside</u> ; <u>nav</u> ; <u>section</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | —                                                                                                                                                                                                                                                                                                                 |
| <u>Phrasing content</u>                   | <u>h1</u> ; <u>h2</u> ; <u>h3</u> ; <u>h4</u> ; <u>h5</u> ; <u>h6</u> ; <u>hgroup</u><br><u>a</u> ; <u>abbr</u> ; <u>audio</u> ; <u>b</u> ; <u>bdi</u> ; <u>bdo</u> ; <u>br</u> ; <u>button</u> ; <u>canvas</u> ; <u>cite</u> ; <u>code</u> ; <u>data</u> ; <u>datalist</u> ; <u>del</u> ; <u>dfn</u> ; <u>em</u> ; <u>embed</u> ; <u>i</u> ; <u>iframe</u> ; <u>img</u> ; <u>input</u> ; <u>ins</u> ; <u>kbd</u> ; <u>label</u> ; <u>map</u> ; <u>mark</u> ; MathML <u>math</u> ; <u>meter</u> ; <u>noscript</u> ; <u>object</u> ; <u>output</u> ; <u>picture</u> ; <u>progress</u> ; <u>q</u> ; <u>ruby</u> ; <u>s</u> ; <u>samp</u> ; <u>script</u> ; <u>select</u> ; <u>slot</u> ; <u>small</u> ; <u>span</u> ; <u>strong</u> ; <u>sub</u> ; <u>sup</u> ; SVG <u>svg</u> ; <u>template</u> ; <u>textarea</u> ; <u>time</u> ; <u>u</u> ; <u>var</u> ; <u>video</u> ; <u>wbr</u> ; autonomous custom elements; Text | <u>area</u> (if it is a descendant of a <u>map</u> element); <u>link</u> (if it is allowed in the body); <u>meta</u> (if the <u>itemprop</u> attribute is present)                                                                                                                                                |
| <u>Embedded content</u>                   | <u>audio</u> ; <u>canvas</u> ; <u>embed</u> ; <u>iframe</u> ; <u>img</u> ; MathML <u>math</u> ; <u>object</u> ; <u>picture</u> ; SVG <u>svg</u> ; <u>video</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | —                                                                                                                                                                                                                                                                                                                 |
| <u>Interactive content</u>                | <u>button</u> ; <u>details</u> ; <u>embed</u> ; <u>iframe</u> ; <u>label</u> ; <u>select</u> ; <u>textarea</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <u>a</u> (if the <u>href</u> attribute is present); <u>audio</u> (if the <u>controls</u> attribute is present); <u>img</u> (if the <u>usemap</u> attribute is present); <u>input</u> (if the <u>type</u> attribute is not in the <u>Hidden</u> state); <u>video</u> (if the <u>controls</u> attribute is present) |
| <u>Sectioning roots</u>                   | <u>blockquote</u> ; <u>body</u> ; <u>details</u> ; <u>dialog</u> ; <u>fieldset</u> ; <u>figure</u> ; <u>td</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | —                                                                                                                                                                                                                                                                                                                 |
| <u>Form-associated elements</u>           | <u>button</u> ; <u>fieldset</u> ; <u>input</u> ; <u>label</u> ; <u>object</u> ; <u>output</u> ; <u>select</u> ; <u>textarea</u> ; <u>img</u> ; form-associated custom elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | —                                                                                                                                                                                                                                                                                                                 |
| <u>Listed elements</u>                    | <u>button</u> ; <u>fieldset</u> ; <u>input</u> ; <u>object</u> ; <u>output</u> ; <u>select</u> ; <u>textarea</u> ; form-associated custom elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | —                                                                                                                                                                                                                                                                                                                 |
| <u>Submittable elements</u>               | <u>button</u> ; <u>input</u> ; <u>select</u> ; <u>textarea</u> ; form-associated custom elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | —                                                                                                                                                                                                                                                                                                                 |
| <u>Resettable elements</u>                | <u>input</u> ; <u>output</u> ; <u>select</u> ; <u>textarea</u> ; form-associated custom elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | —                                                                                                                                                                                                                                                                                                                 |
| <u>Autocapitalize-inheriting elements</u> | <u>button</u> ; <u>fieldset</u> ; <u>input</u> ; <u>output</u> ; <u>select</u> ; <u>textarea</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | —                                                                                                                                                                                                                                                                                                                 |

| Category                          | Elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Elements with exceptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>Labelable elements</u>         | <u>button</u> ; <u>input</u> ; <u>meter</u> ; <u>output</u> ; <u>progress</u> ; <u>select</u> ; <u>textarea</u> ; <u>form-associated custom elements</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <u>Palpable content</u>           | <u>a</u> ; <u>abbr</u> ; <u>address</u> ; <u>article</u> ; <u>aside</u> ; <u>b</u> ; <u>bdi</u> ; <u>bdo</u> ; <u>blockquote</u> ; <u>button</u> ; <u>canvas</u> ; <u>cite</u> ; <u>code</u> ; <u>details</u> ; <u>dfn</u> ; <u>div</u> ; <u>em</u> ; <u>embed</u> ; <u>fieldset</u> ; <u>figure</u> ; <u>footer</u> ; <u>form</u> ; <u>h1</u> ; <u>h2</u> ; <u>h3</u> ; <u>h4</u> ; <u>h5</u> ; <u>h6</u> ; <u>header</u> ; <u>hgroup</u> ; <u>i</u> ; <u>iframe</u> ; <u>img</u> ; <u>ins</u> ; <u>kbd</u> ; <u>label</u> ; <u>main</u> ; <u>map</u> ; <u>mark</u> ; <u>MathML math</u> ; <u>meter</u> ; <u>nav</u> ; <u>object</u> ; <u>output</u> ; <u>p</u> ; <u>pre</u> ; <u>progress</u> ; <u>q</u> ; <u>ruby</u> ; <u>s</u> ; <u>samp</u> ; <u>section</u> ; <u>select</u> ; <u>small</u> ; <u>span</u> ; <u>strong</u> ; <u>sub</u> ; <u>sup</u> ; <u>SVG svg</u> ; <u>table</u> ; <u>textarea</u> ; <u>time</u> ; <u>u</u> ; <u>var</u> ; <u>video</u> ; <u>autonomous custom elements</u> | <u>audio</u> (if the <u>controls</u> attribute is present); <u>dl</u> (if the element's children include at least one name-value group); <u>input</u> (if the <u>type</u> attribute is <i>not</i> in the <u>Hidden</u> state); <u>menu</u> (if the element's children include at least one <u>li</u> element); <u>ol</u> (if the element's children include at least one <u>li</u> element); <u>ul</u> (if the element's children include at least one <u>li</u> element); <u>Text</u> that is not <u>inter-element whitespace</u> |
| <u>Script-supporting elements</u> | <u>script</u> ; <u>template</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## Attributes

*This section is non-normative.*

List of attributes (excluding event handler content attributes)

| Attribute             | Element(s)           | Description                                                                              | Value                                                                                                                                                         |
|-----------------------|----------------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>abbr</b>           | <u>th</u>            | Alternative label to use for the header cell when referencing the cell in other contexts | <u>Text</u> *                                                                                                                                                 |
| <b>accept</b>         | <u>input</u>         | Hint for expected file type in <u>file upload controls</u>                               | <u>Set of comma-separated tokens</u> * consisting of <u>valid MIME type strings with no parameters</u> or <u>audio/*</u> , <u>video/*</u> , or <u>image/*</u> |
| <b>accept-charset</b> | <u>form</u>          | Character encodings to use for <u>form submission</u>                                    | <u>ASCII case-insensitive</u> match for <u>"UTF-8"</u>                                                                                                        |
| <b>accesskey</b>      | <u>HTML elements</u> | Keyboard shortcut to activate or focus element                                           | <u>Ordered set of unique space-separated tokens</u> , none of which are <u>identical to</u> another, each consisting of one code point in length              |

| Attribute              | Element(s)                                                                                 | Description                                                                                                              | Value                                                                                                                                                         |
|------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>action</b>          | <a href="#">form</a>                                                                       | URL to use for <a href="#">form</a> submission                                                                           | Valid non-empty URL potentially surrounded by spaces                                                                                                          |
| <b>allow</b>           | <a href="#">iframe</a>                                                                     | Permissions policy to be applied to the <a href="#">iframe</a> 's contents                                               | Serialized permissions policy                                                                                                                                 |
| <b>allowfullscreen</b> | <a href="#">iframe</a>                                                                     | Whether to allow the <a href="#">iframe</a> 's contents to use <a href="#">requestFullscreen()</a>                       | <a href="#">Boolean attribute</a>                                                                                                                             |
| <b>alt</b>             | <a href="#">area</a> ; <a href="#">img</a> ; <a href="#">input</a>                         | Replacement text for use when images are not available                                                                   | <a href="#">Text*</a>                                                                                                                                         |
| <b>as</b>              | <a href="#">link</a>                                                                       | Potential destination for a preload request (for <a href="#">rel="preload"</a> and <a href="#">rel="modulepreload"</a> ) | <a href="#">Potential destination</a> , for <a href="#">rel="preload"</a> ; <a href="#">script-like destination</a> , for <a href="#">rel="modulepreload"</a> |
| <b>async</b>           | <a href="#">script</a>                                                                     | Execute script when available, without blocking while fetching                                                           | <a href="#">Boolean attribute</a>                                                                                                                             |
| <b>autocapitalize</b>  | <a href="#">HTML elements</a>                                                              | Recommended autocapitalization behavior (for supported input methods)                                                    | <a href="#">"on"; "off"; "none"; "sentences"; "words"; "characters"</a>                                                                                       |
| <b>autocomplete</b>    | <a href="#">form</a>                                                                       | Default setting for autofill feature for controls in the form                                                            | <a href="#">"on"; "off"</a>                                                                                                                                   |
| <b>autocomplete</b>    | <a href="#">input</a> ; <a href="#">select</a> ; <a href="#">textarea</a>                  | Hint for form autofill feature                                                                                           | <a href="#">Autofill field</a> name and related tokens*                                                                                                       |
| <b>autofocus</b>       | <a href="#">HTML elements</a>                                                              | Automatically focus the element when the page is loaded                                                                  | <a href="#">Boolean attribute</a>                                                                                                                             |
| <b>autoplay</b>        | <a href="#">audio</a> ; <a href="#">video</a>                                              | Hint that the <a href="#">media resource</a> can be started automatically when the page is loaded                        | <a href="#">Boolean attribute</a>                                                                                                                             |
| <b>charset</b>         | <a href="#">meta</a>                                                                       | <a href="#">Character encoding declaration</a>                                                                           | <a href="#">"utf-8"</a>                                                                                                                                       |
| <b>checked</b>         | <a href="#">input</a>                                                                      | Whether the control is checked                                                                                           | <a href="#">Boolean attribute</a>                                                                                                                             |
| <b>cite</b>            | <a href="#">blockquote</a> ; <a href="#">del</a> ; <a href="#">ins</a> ; <a href="#">q</a> | Link to the source of the quotation or more information about the edit                                                   | Valid URL potentially surrounded by spaces                                                                                                                    |
| <b>class</b>           | <a href="#">HTML</a>                                                                       | Classes to which the                                                                                                     | <a href="#">Set of space-separated tokens</a>                                                                                                                 |

| Attribute              | Element(s)                                                                                                          | Description                                                                     | Value                                                                                                                                                                                                                                                                             |
|------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <a href="#">elements</a>                                                                                            | element belongs                                                                 |                                                                                                                                                                                                                                                                                   |
| <b>color</b>           | <a href="#">link</a>                                                                                                | Color to use when customizing a site's icon (for <code>rel="mask-icon"</code> ) | CSS <a href="#"><code>&lt;color&gt;</code></a>                                                                                                                                                                                                                                    |
| <b>cols</b>            | <a href="#">textarea</a>                                                                                            | Maximum number of characters per line                                           | <a href="#">Valid non-negative integer greater than zero</a>                                                                                                                                                                                                                      |
| <b>colspan</b>         | <a href="#">td</a> ; <a href="#">th</a>                                                                             | Number of columns that the cell is to span                                      | <a href="#">Valid non-negative integer greater than zero</a>                                                                                                                                                                                                                      |
| <b>content</b>         | <a href="#">meta</a>                                                                                                | Value of the element                                                            | <a href="#">Text*</a>                                                                                                                                                                                                                                                             |
| <b>contenteditable</b> | <a href="#">HTML elements</a>                                                                                       | Whether the element is editable                                                 | <code>"true"; "false"</code>                                                                                                                                                                                                                                                      |
| <b>controls</b>        | <a href="#">audio</a> ; <a href="#">video</a>                                                                       | Show user agent controls                                                        | <a href="#">Boolean attribute</a>                                                                                                                                                                                                                                                 |
| <b>coords</b>          | <a href="#">area</a>                                                                                                | Coordinates for the shape to be created in an <a href="#">image map</a>         | <a href="#">Valid list of floating-point numbers*</a>                                                                                                                                                                                                                             |
| <b>crossorigin</b>     | <a href="#">audio</a> ; <a href="#">img</a> ; <a href="#">link</a> ; <a href="#">script</a> ; <a href="#">video</a> | How the element handles crossorigin requests                                    | <a href="#">"anonymous"; "use-credentials"</a>                                                                                                                                                                                                                                    |
| <b>data</b>            | <a href="#">object</a>                                                                                              | Address of the resource                                                         | <a href="#">Valid non-empty URL potentially surrounded by spaces</a>                                                                                                                                                                                                              |
| <b>datetime</b>        | <a href="#">del</a> ; <a href="#">ins</a>                                                                           | Date and (optionally) time of the change                                        | <a href="#">Valid date string with optional time</a>                                                                                                                                                                                                                              |
| <b>datetime</b>        | <a href="#">time</a>                                                                                                | Machine-readable value                                                          | <a href="#">Valid month string, valid date string, valid yearless date string, valid time string, valid local date and time string, valid time-zone offset string, valid global date and time string, valid week string, valid non-negative integer, or valid duration string</a> |
| <b>decoding</b>        | <a href="#">img</a>                                                                                                 | Decoding hint to use when processing this image for presentation                | <code>"sync"; "async"; "auto"</code>                                                                                                                                                                                                                                              |
| <b>default</b>         | <a href="#">track</a>                                                                                               | Enable the track if no other <a href="#">text track</a> is more suitable        | <a href="#">Boolean attribute</a>                                                                                                                                                                                                                                                 |
| <b>defer</b>           | <a href="#">script</a>                                                                                              | Defer script execution                                                          | <a href="#">Boolean attribute</a>                                                                                                                                                                                                                                                 |
| <b>dir</b>             | <a href="#">HTML elements</a>                                                                                       | <a href="#">The text directionality</a> of the element                          | <code>"ltr"; "rtl"; "auto"</code>                                                                                                                                                                                                                                                 |
| <b>dir</b>             | <a href="#">bdo</a>                                                                                                 | <a href="#">The text directionality</a> of the element                          | <code>"ltr"; "rtl"</code>                                                                                                                                                                                                                                                         |

| Attribute           | Element(s)                                                                                                                                                                                               | Description                                                                                                    | Value                                                                                                                                                                                     |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>dirname</b>      | <a href="#">input</a> ; <a href="#">textarea</a>                                                                                                                                                         | Name of form control to use for sending the element's <a href="#">directionality</a> in <a href="#">Text</a> * |                                                                                                                                                                                           |
| <b>disabled</b>     | <a href="#">button</a> ; <a href="#">input</a> ; <a href="#">optgroup</a> ; <a href="#">option</a> ; <a href="#">select</a> ; <a href="#">textarea</a> ; <a href="#">form-associated custom elements</a> | Whether the form control is disabled                                                                           | <a href="#">Boolean attribute</a>                                                                                                                                                         |
| <b>disabled</b>     | <a href="#">fieldset</a>                                                                                                                                                                                 | Whether the descendant form controls, except any inside <a href="#">legend</a> , are disabled                  | <a href="#">Boolean attribute</a>                                                                                                                                                         |
| <b>disabled</b>     | <a href="#">link</a>                                                                                                                                                                                     | Whether the link is disabled                                                                                   | <a href="#">Boolean attribute</a>                                                                                                                                                         |
| <b>download</b>     | <a href="#">a</a> ; <a href="#">area</a>                                                                                                                                                                 | Whether to download the resource instead of navigating to it, and its filename if so                           | Text                                                                                                                                                                                      |
| <b>draggable</b>    | <a href="#">HTML elements</a>                                                                                                                                                                            | Whether the element is draggable                                                                               | "true"; "false"                                                                                                                                                                           |
| <b>enctype</b>      | <a href="#">form</a>                                                                                                                                                                                     | Entry list encoding type to use for <a href="#">form submission</a>                                            | <a href="#">application/x-www-form-urlencoded</a> "; " <a href="#">multipart/form-data</a> "; " <a href="#">text/plain</a> "                                                              |
| <b>enterkeyhint</b> | <a href="#">HTML elements</a>                                                                                                                                                                            | Hint for selecting an enter key action                                                                         | " <a href="#">enter</a> "; " <a href="#">done</a> "; " <a href="#">go</a> "; " <a href="#">next</a> "; " <a href="#">previous</a> "; " <a href="#">search</a> "; " <a href="#">send</a> " |
| <b>for</b>          | <a href="#">label</a>                                                                                                                                                                                    | Associate the label with form control                                                                          | <a href="#">ID</a> *                                                                                                                                                                      |
| <b>for</b>          | <a href="#">output</a>                                                                                                                                                                                   | Specifies controls from which the output was calculated                                                        | Unordered set of <a href="#">unique space-separated tokens</a> consisting of IDs*                                                                                                         |
| <b>form</b>         | <a href="#">button</a> ; <a href="#">fieldset</a> ; <a href="#">input</a> ; <a href="#">object</a> ; <a href="#">output</a> ; <a href="#">select</a> ; <a href="#">textarea</a> ; <a href="#">form-</a>  | Associates the element with a <a href="#">form</a> element                                                     | <a href="#">ID</a> *                                                                                                                                                                      |

| Attribute             | Element(s)                                                                                                                                                                                                                   | Description                                                         | Value                                                                                                                                                                        |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <a href="#">associated custom elements</a>                                                                                                                                                                                   |                                                                     |                                                                                                                                                                              |
| <b>formaction</b>     | <a href="#">button</a> ; <a href="#">input</a>                                                                                                                                                                               | URL to use for <a href="#">form submission</a>                      | Valid non-empty URL potentially surrounded by spaces                                                                                                                         |
| <b>formenctype</b>    | <a href="#">button</a> ; <a href="#">input</a>                                                                                                                                                                               | Entry list encoding type to use for <a href="#">form submission</a> | <a href="#">"application/x-www-form-urlencoded"</a> ; <a href="#">"multipart/form-data"</a> ; <a href="#">"text/plain"</a>                                                   |
| <b>formmethod</b>     | <a href="#">button</a> ; <a href="#">input</a>                                                                                                                                                                               | Variant to use for <a href="#">form submission</a>                  | "GET"; "POST"; "dialog"                                                                                                                                                      |
| <b>formnovalidate</b> | <a href="#">button</a> ; <a href="#">input</a>                                                                                                                                                                               | Bypass form control validation for <a href="#">form submission</a>  | Boolean attribute                                                                                                                                                            |
| <b>formtarget</b>     | <a href="#">button</a> ; <a href="#">input</a>                                                                                                                                                                               | Browsing context for form submission                                | Valid browsing context name or keyword                                                                                                                                       |
| <b>headers</b>        | <a href="#">td</a> ; <a href="#">th</a>                                                                                                                                                                                      | The header cells for this cell                                      | Unordered set of <a href="#">unique space-separated tokens</a> consisting of IDs*                                                                                            |
|                       | <a href="#">canvas</a> ; <a href="#">embed</a> ; <a href="#">iframe</a> ; <a href="#">img</a> ; <a href="#">input</a> ; <a href="#">object</a> ; <a href="#">source</a> (in <a href="#">picture</a> ); <a href="#">video</a> |                                                                     |                                                                                                                                                                              |
| <b>height</b>         | <a href="#">HTML elements</a>                                                                                                                                                                                                | Vertical dimension                                                  | Valid non-negative integer                                                                                                                                                   |
| <b>hidden</b>         | <a href="#">HTML elements</a>                                                                                                                                                                                                | Whether the element is relevant                                     | Boolean attribute                                                                                                                                                            |
| <b>high</b>           | <a href="#">meter</a>                                                                                                                                                                                                        | Low limit of high range                                             | Valid floating-point number*                                                                                                                                                 |
| <b>href</b>           | <a href="#">a</a> ; <a href="#">area</a>                                                                                                                                                                                     | Address of the <a href="#">hyperlink</a>                            | Valid URL potentially surrounded by spaces                                                                                                                                   |
| <b>href</b>           | <a href="#">link</a>                                                                                                                                                                                                         | Address of the <a href="#">hyperlink</a>                            | Valid non-empty URL potentially surrounded by spaces                                                                                                                         |
| <b>href</b>           | <a href="#">base</a>                                                                                                                                                                                                         | Document base URL                                                   | Valid URL potentially surrounded by spaces                                                                                                                                   |
| <b>hreflang</b>       | <a href="#">a</a> ; <a href="#">link</a>                                                                                                                                                                                     | Language of the linked resource                                     | Valid BCP 47 language tag                                                                                                                                                    |
| <b>http-equiv</b>     | <a href="#">meta</a>                                                                                                                                                                                                         | Pragma directive                                                    | <a href="#">"content-type"</a> ; <a href="#">"default-style"</a> ; <a href="#">"refresh"</a> ; <a href="#">"x-ua-compatible"</a> ; <a href="#">"content-security-policy"</a> |
| <b>id</b>             | <a href="#">HTML elements</a>                                                                                                                                                                                                | The element's ID                                                    | Text*                                                                                                                                                                        |

| Attribute          | Element(s)                                                                | Description                                                                                                                      | Value                                                                                                                                                                                                |
|--------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>imagesizes</b>  | <a href="#">link</a>                                                      | Image sizes for different page layouts (for <a href="#">rel="preload"</a> )                                                      | <a href="#">Valid source size list</a>                                                                                                                                                               |
| <b>imagesrcset</b> | <a href="#">link</a>                                                      | Images to use in different situations, e.g., high-resolution displays, small monitors, etc. (for <a href="#">rel="preload"</a> ) | Comma-separated list of <a href="#">image candidate strings</a>                                                                                                                                      |
| <b>inputmode</b>   | <a href="#">HTML elements</a>                                             | Hint for selecting an input modality                                                                                             | <a href="#">"none"; "text"; "tel"; "email"; "url"; "numeric"; "decimal"; "search"</a>                                                                                                                |
| <b>integrity</b>   | <a href="#">link</a> ; <a href="#">script</a>                             | Integrity metadata used in <i>Subresource Integrity</i> checks <a href="#">[SRI]</a>                                             | <a href="#">Text</a>                                                                                                                                                                                 |
| <b>is</b>          | <a href="#">HTML elements</a>                                             | Creates a <a href="#">customized built-in element</a>                                                                            | <a href="#">Valid custom element name</a> of a defined <a href="#">customized built-in element</a>                                                                                                   |
| <b>ismap</b>       | <a href="#">img</a>                                                       | Whether the image is a server-side image map                                                                                     | <a href="#">Boolean attribute</a>                                                                                                                                                                    |
| <b>itemid</b>      | <a href="#">HTML elements</a>                                             | <a href="#">Global identifier</a> for a microdata item                                                                           | <a href="#">Valid URL potentially surrounded by spaces</a>                                                                                                                                           |
| <b>itemprop</b>    | <a href="#">HTML elements</a>                                             | <a href="#">Property names</a> of a microdata item                                                                               | <a href="#">Unordered set of unique space-separated tokens</a> consisting of <a href="#">valid absolute URLs</a> , <a href="#">defined property names</a> , or <a href="#">text*</a>                 |
| <b>itemref</b>     | <a href="#">HTML elements</a>                                             | <a href="#">Referenced</a> elements                                                                                              | <a href="#">Unordered set of unique space-separated tokens</a> consisting of IDs*                                                                                                                    |
| <b>itemscope</b>   | <a href="#">HTML elements</a>                                             | Introduces a microdata item                                                                                                      | <a href="#">Boolean attribute</a>                                                                                                                                                                    |
| <b>itemtype</b>    | <a href="#">HTML elements</a>                                             | <a href="#">Item types</a> of a microdata item                                                                                   | <a href="#">Unordered set of unique space-separated tokens</a> consisting of <a href="#">valid absolute URLs*</a><br><a href="#">"subtitles"; "captions"; "descriptions"; "chapters"; "metadata"</a> |
| <b>kind</b>        | <a href="#">track</a>                                                     | The type of text track                                                                                                           | <a href="#">"subtitles"; "captions"; "descriptions"; "chapters"; "metadata"</a>                                                                                                                      |
| <b>label</b>       | <a href="#">optgroup</a> ; <a href="#">option</a> ; <a href="#">track</a> | User-visible label                                                                                                               | <a href="#">Text</a>                                                                                                                                                                                 |
| <b>lang</b>        | <a href="#">HTML elements</a>                                             | <a href="#">Language</a> of the element                                                                                          | <a href="#">Valid BCP 47 language tag or the empty string</a>                                                                                                                                        |
| <b>list</b>        | <a href="#">input</a>                                                     | List of autocomplete options                                                                                                     | <a href="#">ID*</a>                                                                                                                                                                                  |
| <b>loading</b>     | <a href="#">img</a> ; <a href="#">iframe</a>                              | Used when determining                                                                                                            | <a href="#">"lazy"; "eager"</a>                                                                                                                                                                      |

| Attribute         | Element(s)                                                                                                                                                                  | Description                                                                                                 | Value                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
|                   |                                                                                                                                                                             | loading deferral                                                                                            |                                                                               |
| <b>loop</b>       | <a href="#">audio</a> ; <a href="#">video</a>                                                                                                                               | Whether to loop the <a href="#">media resource</a>                                                          | <a href="#">Boolean attribute</a>                                             |
| <b>low</b>        | <a href="#">meter</a>                                                                                                                                                       | High limit of low range                                                                                     | <a href="#">Valid floating-point number*</a>                                  |
| <b>max</b>        | <a href="#">input</a>                                                                                                                                                       | Maximum value                                                                                               | Varies*                                                                       |
| <b>max</b>        | <a href="#">meter</a> ; <a href="#">progress</a>                                                                                                                            | Upper bound of range                                                                                        | <a href="#">Valid floating-point number*</a>                                  |
| <b>maxlength</b>  | <a href="#">input</a> ; <a href="#">textarea</a>                                                                                                                            | Maximum <a href="#">length</a> of value                                                                     | <a href="#">Valid non-negative integer</a>                                    |
| <b>media</b>      | <a href="#">link</a> ; <a href="#">meta</a> ; <a href="#">source</a> (in <a href="#">picture</a> ); <a href="#">style</a>                                                   | Applicable media                                                                                            | <a href="#">Valid media query list</a>                                        |
| <b>method</b>     | <a href="#">form</a>                                                                                                                                                        | Variant to use for <a href="#">form submission</a>                                                          | " <a href="#">GET</a> "; " <a href="#">POST</a> "; " <a href="#">dialog</a> " |
| <b>min</b>        | <a href="#">input</a>                                                                                                                                                       | Minimum value                                                                                               | Varies*                                                                       |
| <b>min</b>        | <a href="#">meter</a>                                                                                                                                                       | Lower bound of range                                                                                        | <a href="#">Valid floating-point number*</a>                                  |
| <b> minlength</b> | <a href="#">input</a> ; <a href="#">textarea</a>                                                                                                                            | Minimum <a href="#">length</a> of value                                                                     | <a href="#">Valid non-negative integer</a>                                    |
| <b>multiple</b>   | <a href="#">input</a> ; <a href="#">select</a>                                                                                                                              | Whether to allow multiple values                                                                            | <a href="#">Boolean attribute</a>                                             |
| <b>muted</b>      | <a href="#">audio</a> ; <a href="#">video</a> ; <a href="#">button</a> ; <a href="#">fieldset</a> ; <a href="#">input</a> ; <a href="#">output</a> ; <a href="#">select</a> | Whether to mute the <a href="#">media resource</a> by default                                               | <a href="#">Boolean attribute</a>                                             |
| <b>name</b>       | <a href="#">input</a> ; <a href="#">output</a> ; <a href="#">select</a> ; <a href="#">textarea</a> ; <a href="#">form-associated custom elements</a>                        | Name of the element to use for <a href="#">form submission</a> and in the <a href="#">form.elements</a> API | <a href="#">Text*</a>                                                         |
| <b>name</b>       | <a href="#">form</a>                                                                                                                                                        | Name of form to use in the <a href="#">document.forms</a> API                                               | <a href="#">Text*</a>                                                         |
| <b>name</b>       | <a href="#">iframe</a> ; <a href="#">object</a>                                                                                                                             | Name of <a href="#">nested browsing context</a>                                                             | <a href="#">Valid browsing context name or keyword</a>                        |
| <b>name</b>       | <a href="#">map</a>                                                                                                                                                         | Name of <a href="#">image map</a> to reference from the <a href="#">usemap</a> attribute                    | <a href="#">Text*</a>                                                         |
| <b>name</b>       | <a href="#">meta</a>                                                                                                                                                        | Metadata name                                                                                               | <a href="#">Text*</a>                                                         |

| Attribute             | Element(s)                                         | Description                                                                                 | Value                                                                                                                                                                             |
|-----------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>name</b>           | <a href="#">param</a>                              | Name of parameter                                                                           | <a href="#">Text</a>                                                                                                                                                              |
| <b>name</b>           | <a href="#">slot</a>                               | Name of shadow tree slot                                                                    | <a href="#">Text</a>                                                                                                                                                              |
| <b>nomodule</b>       | <a href="#">script</a>                             | Prevents execution in user agents that support <a href="#">module scripts</a>               | <a href="#">Boolean attribute</a>                                                                                                                                                 |
| <b>nonce</b>          | <a href="#">HTML elements</a>                      | Cryptographic nonce used in <i>Content Security Policy</i> checks <a href="#">[CSP]</a>     | <a href="#">Text</a>                                                                                                                                                              |
| <b>novalidate</b>     | <a href="#">form</a>                               | Bypass form control validation for <a href="#">form submission</a>                          | <a href="#">Boolean attribute</a>                                                                                                                                                 |
| <b>open</b>           | <a href="#">details</a>                            | Whether the details are visible                                                             | <a href="#">Boolean attribute</a>                                                                                                                                                 |
| <b>open</b>           | <a href="#">dialog</a>                             | Whether the dialog box is showing                                                           | <a href="#">Boolean attribute</a>                                                                                                                                                 |
| <b>optimum</b>        | <a href="#">meter</a>                              | Optimum value in gauge                                                                      | <a href="#">Valid floating-point number*</a>                                                                                                                                      |
| <b>pattern</b>        | <a href="#">input</a>                              | Pattern to be matched by the form control's value                                           | Regular expression matching the JavaScript <a href="#">Pattern</a> production<br><a href="#">Set of space-separated tokens</a> consisting of <a href="#">valid non-empty URLs</a> |
| <b>ping</b>           | <a href="#">a; area</a>                            | <a href="#">URLs</a> to ping                                                                |                                                                                                                                                                                   |
| <b>placeholder</b>    | <a href="#">input; textarea</a>                    | User-visible label to be placed within the form control                                     | <a href="#">Text*</a>                                                                                                                                                             |
| <b>playsinline</b>    | <a href="#">video</a>                              | Encourage the user agent to display video content within the element's playback area        | <a href="#">Boolean attribute</a>                                                                                                                                                 |
| <b>poster</b>         | <a href="#">video</a>                              | Poster frame to show prior to video playback                                                | <a href="#">Valid non-empty URL potentially surrounded by spaces</a>                                                                                                              |
| <b>preload</b>        | <a href="#">audio; video</a>                       | Hints how much buffering the <a href="#">media resource</a> will likely need                | <a href="#">"none"; "metadata"; "auto"</a>                                                                                                                                        |
| <b>readonly</b>       | <a href="#">input; textarea</a>                    | Whether to allow the value to be edited by the user                                         | <a href="#">Boolean attribute</a>                                                                                                                                                 |
| <b>readonly</b>       | <a href="#">form-associated custom elements</a>    | Affects <a href="#">willValidate</a> , plus any behavior added by the custom element author | <a href="#">Boolean attribute</a>                                                                                                                                                 |
| <b>referrerpolicy</b> | <a href="#">a; area; iframe; img; link; script</a> | Referrer policy for <a href="#">fetches</a> initiated by the element                        | <a href="#">Referrer policy</a>                                                                                                                                                   |

| Attribute       | Element(s)                                                                | Description                                                                                                             | Value                                                                                                                                                                                                                                                                                                                        |
|-----------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>rel</b>      | <a>; area</a>                                                             | Relationship between the location in the document containing the <a href="#">hyperlink</a> and the destination resource | <a href="#">Unordered set of unique space-separated tokens*</a>                                                                                                                                                                                                                                                              |
| <b>rel</b>      | <a href="#">link</a>                                                      | Relationship between the document containing the <a href="#">hyperlink</a> and the destination resource                 | <a href="#">Unordered set of unique space-separated tokens*</a>                                                                                                                                                                                                                                                              |
| <b>required</b> | <a href="#">input</a> ; <a href="#">select</a> ; <a href="#">textarea</a> | Whether the control is required for <a href="#">form submission</a>                                                     | <a href="#">Boolean attribute</a>                                                                                                                                                                                                                                                                                            |
| <b>reversed</b> | <a href="#">ol</a>                                                        | Number the list backwards                                                                                               | <a href="#">Boolean attribute</a>                                                                                                                                                                                                                                                                                            |
| <b>rows</b>     | <a href="#">textarea</a>                                                  | Number of lines to show                                                                                                 | <a href="#">Valid non-negative integer greater than zero</a>                                                                                                                                                                                                                                                                 |
| <b>rowspan</b>  | <a href="#">td</a> ; <a href="#">th</a>                                   | Number of rows that the cell is to span                                                                                 | <a href="#">Valid non-negative integer</a>                                                                                                                                                                                                                                                                                   |
| <b>sandbox</b>  | <a href="#">iframe</a>                                                    | Security rules for nested content                                                                                       | <a href="#">Unordered set of unique space-separated tokens, ASCII case-insensitive, consisting of "allow-forms", "allow-modals", "allow-orientation-lock", "allow-pointer-lock", "allow-popups", "allow-popups-to-escape-sandbox", "allow-presentation", "allow-same-origin", "allow-scripts" and "allow-top-navigation"</a> |
| <b>scope</b>    | <a href="#">th</a>                                                        | Specifies which cells the header cell applies to                                                                        | <a href="#">"row"; "col"; "rowgroup"; "colgroup"</a>                                                                                                                                                                                                                                                                         |
| <b>selected</b> | <a href="#">option</a>                                                    | Whether the option is selected by default                                                                               | <a href="#">Boolean attribute</a>                                                                                                                                                                                                                                                                                            |
| <b>shape</b>    | <a href="#">area</a>                                                      | The kind of shape to be created in an <a href="#">image map</a>                                                         | <a href="#">"circle"; "default"; "poly"; "rect"</a>                                                                                                                                                                                                                                                                          |
| <b>size</b>     | <a href="#">input</a> ; <a href="#">select</a>                            | Size of the control                                                                                                     | <a href="#">Valid non-negative integer greater than zero</a>                                                                                                                                                                                                                                                                 |
| <b>sizes</b>    | <a href="#">link</a>                                                      | Sizes of the icons (for <a href="#">rel="icon"</a> )                                                                    | <a href="#">Unordered set of unique space-separated tokens, ASCII case-insensitive, consisting of sizes*</a>                                                                                                                                                                                                                 |
| <b>sizes</b>    | <a href="#">img</a> ; <a href="#">source</a>                              | Image sizes for different page layouts                                                                                  | <a href="#">Valid source size list</a>                                                                                                                                                                                                                                                                                       |

| Attribute         | Element(s)                                                                                                                                                                                                                                                                 | Description                                                                                                                                                                                         | Value                                                                   |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <b>slot</b>       | <a href="#">HTML elements</a>                                                                                                                                                                                                                                              | The element's desired slot                                                                                                                                                                          | <a href="#">Text</a>                                                    |
| <b>span</b>       | <a href="#">col</a> ; <a href="#">colgroup</a>                                                                                                                                                                                                                             | Number of columns spanned by the element                                                                                                                                                            | <a href="#">Valid non-negative integer greater than zero</a>            |
| <b>spellcheck</b> | <a href="#">HTML elements</a>                                                                                                                                                                                                                                              | Whether the element is to have its spelling and grammar checked                                                                                                                                     | "true"; "false"                                                         |
| <b>src</b>        | <a href="#">audio</a> ; <a href="#">embed</a> ; <a href="#">iframe</a> ; <a href="#">img</a> ; <a href="#">input</a> ; <a href="#">script</a> ; <a href="#">source</a> (in <a href="#">video</a> or <a href="#">audio</a> ); <a href="#">track</a> ; <a href="#">video</a> | Address of the resource                                                                                                                                                                             | <a href="#">Valid non-empty URL potentially surrounded by spaces</a>    |
| <b>srcdoc</b>     | <a href="#">iframe</a>                                                                                                                                                                                                                                                     | A document to render in the <a href="#">iframe</a>                                                                                                                                                  | The source of <a href="#">an iframe srcdoc document*</a>                |
| <b>srlang</b>     | <a href="#">track</a>                                                                                                                                                                                                                                                      | Language of the text track                                                                                                                                                                          | Valid BCP 47 language tag                                               |
| <b>srcset</b>     | <a href="#">img</a> ; <a href="#">source</a>                                                                                                                                                                                                                               | Images to use in different situations, e.g., high-resolution displays, small monitors, etc.                                                                                                         | Comma-separated list of <a href="#">image candidate strings</a>         |
| <b>start</b>      | <a href="#">ol</a>                                                                                                                                                                                                                                                         | <a href="#">Starting value</a> of the list                                                                                                                                                          | <a href="#">Valid integer</a>                                           |
| <b>step</b>       | <a href="#">input</a>                                                                                                                                                                                                                                                      | Granularity to be matched by the form control's value                                                                                                                                               | <a href="#">Valid floating-point number greater than zero, or "any"</a> |
| <b>style</b>      | <a href="#">HTML elements</a>                                                                                                                                                                                                                                              | Presentational and formatting instructions                                                                                                                                                          | CSS declarations*                                                       |
| <b>tabindex</b>   | <a href="#">HTML elements</a>                                                                                                                                                                                                                                              | Whether the element is <a href="#">focusable</a> and <a href="#">sequentially focusable</a> , and the relative order of the element for the purposes of <a href="#">sequential focus navigation</a> | <a href="#">Valid integer</a>                                           |
| <b>target</b>     | <a href="#">a</a> ; <a href="#">area</a>                                                                                                                                                                                                                                   | Browsing context for <a href="#">hyperlink navigation</a>                                                                                                                                           | <a href="#">Valid browsing context name or keyword</a>                  |
| <b>target</b>     | <a href="#">base</a>                                                                                                                                                                                                                                                       | Default <a href="#">browsing context</a> for <a href="#">hyperlink navigation</a> and <a href="#">form submission</a>                                                                               | <a href="#">Valid browsing context name or keyword</a>                  |
| <b>target</b>     | <a href="#">form</a>                                                                                                                                                                                                                                                       | Browsing context for                                                                                                                                                                                | <a href="#">Valid browsing context name or keyword</a>                  |

| Attribute        | Element(s)                                                                                             | Description                                                               | Value                                                                                                                                          |
|------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <a href="#">form submission</a>                                                                        | <a href="#">keyword</a>                                                   |                                                                                                                                                |
| <b>title</b>     | <a href="#">HTML elements</a>                                                                          | Advisory information for the element                                      | <a href="#">Text</a>                                                                                                                           |
| <b>title</b>     | <a href="#">abbr</a> ; <a href="#">dfn</a>                                                             | Full term or expansion of abbreviation                                    | <a href="#">Text</a>                                                                                                                           |
| <b>title</b>     | <a href="#">input</a>                                                                                  | Description of pattern (when used with <a href="#">pattern</a> attribute) | <a href="#">Text</a>                                                                                                                           |
| <b>title</b>     | <a href="#">link</a>                                                                                   | Title of the link                                                         | <a href="#">Text</a>                                                                                                                           |
| <b>title</b>     | <a href="#">link</a> ; <a href="#">style</a>                                                           | <a href="#">CSS style sheet set name</a>                                  | <a href="#">Text</a>                                                                                                                           |
| <b>translate</b> | <a href="#">HTML elements</a>                                                                          | Whether the element is to be translated when the page is localized        | "yes"; "no"                                                                                                                                    |
| <b>type</b>      | <a href="#">a</a> ; <a href="#">link</a>                                                               | Hint for the type of the referenced resource                              | <a href="#">Valid MIME type string</a>                                                                                                         |
| <b>type</b>      | <a href="#">button</a>                                                                                 | Type of button                                                            | "submit"; "reset"; "button"                                                                                                                    |
| <b>type</b>      | <a href="#">embed</a> ; <a href="#">object</a> ; <a href="#">source</a>                                | Type of embedded resource                                                 | <a href="#">Valid MIME type string</a>                                                                                                         |
| <b>type</b>      | <a href="#">input</a>                                                                                  | Type of form control                                                      | <a href="#">input type keyword</a>                                                                                                             |
| <b>type</b>      | <a href="#">ol</a>                                                                                     | Kind of list marker                                                       | "1"; "a"; "A"; "i"; "I"<br>"module"; a <a href="#">valid MIME type string</a> that is not a <a href="#">JavaScript MIME type essence match</a> |
| <b>type</b>      | <a href="#">script</a>                                                                                 | Type of script                                                            |                                                                                                                                                |
| <b>usemap</b>    | <a href="#">img</a>                                                                                    | Name of <a href="#">image map</a> to use                                  | <a href="#">Valid hash-name reference*</a>                                                                                                     |
| <b>value</b>     | <a href="#">button</a> ; <a href="#">option</a>                                                        | Value to be used for <a href="#">form submission</a>                      | <a href="#">Text</a>                                                                                                                           |
| <b>value</b>     | <a href="#">data</a>                                                                                   | Machine-readable value                                                    | <a href="#">Text</a> *                                                                                                                         |
| <b>value</b>     | <a href="#">input</a>                                                                                  | Value of the form control                                                 | Varies*                                                                                                                                        |
| <b>value</b>     | <a href="#">li</a>                                                                                     | <a href="#">Ordinal value</a> of the list item                            | <a href="#">Valid integer</a>                                                                                                                  |
| <b>value</b>     | <a href="#">meter</a> ; <a href="#">progress</a>                                                       | Current value of the element                                              | <a href="#">Valid floating-point number</a>                                                                                                    |
| <b>value</b>     | <a href="#">param</a>                                                                                  | Value of parameter                                                        | <a href="#">Text</a>                                                                                                                           |
|                  | <a href="#">canvas</a> ; <a href="#">embed</a> ; <a href="#">iframe</a> ; <a href="#">img</a> ;        |                                                                           |                                                                                                                                                |
| <b>width</b>     | <a href="#">input</a> ; <a href="#">object</a> ; <a href="#">source</a> (in <a href="#">picture</a> ); | Horizontal dimension                                                      | <a href="#">Valid non-negative integer</a>                                                                                                     |

| Attribute   | Element(s)               | Description                                                                            | Value                                              |
|-------------|--------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------|
|             | <a href="#">video</a>    |                                                                                        |                                                    |
| <b>wrap</b> | <a href="#">textarea</a> | How the value of the form control is to be wrapped for <a href="#">form submission</a> | " <a href="#">soft</a> "; " <a href="#">hard</a> " |

An asterisk (\*) in a cell indicates that the actual rules are more complicated than indicated in the table above.



### [GlobalEventHandlers/ondrag](#)

Support in all current engines.

Firefox 9+ Safari 3.1+ Chrome 1+

Opera 12+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 2+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12+

### [GlobalEventHandlers/ondragend](#)

Support in all current engines.

Firefox 9+ Safari 3.1+ Chrome 1+

Opera 12+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 2+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12+

### [GlobalEventHandlers/ondragenter](#)

Support in all current engines.

Firefox 9+ Safari 3.1+ Chrome 1+

Opera 12+ Edge 79+

Edge (Legacy) 12+ Internet Explorer 9+

Firefox Android 9+ Safari iOS 2+ Chrome Android 18+ WebView Android 1+ Samsung Internet 1.0+ Opera Android 12+

### [GlobalEventHandlers/ondragleave](#)

Support in all current engines.

Firefox 9+ Safari 3.1+ Chrome 1+

Opera12+Edge79+

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Edge (Legacy)12+Internet Explorer9+

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Firefox Android9+Safari iOS2+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12+

### [GlobalEventHandlers/ondragover](#)

Support in all current engines.

Firefox9+Safari3.1+Chrome1+

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Opera12+Edge79+

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Edge (Legacy)12+Internet Explorer9+

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Firefox Android9+Safari iOS2+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12+

### [GlobalEventHandlers/ondragstart](#)

Support in all current engines.

Firefox9+Safari3.1+Chrome1+

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Opera12+Edge79+

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Edge (Legacy)12+Internet Explorer9+

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Firefox Android9+Safari iOS2+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12+

### [GlobalEventHandlers/ondrop](#)

Support in all current engines.

Firefox9+Safari3.1+Chrome1+

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Opera12+Edge79+

---

Edge (Legacy)12+Internet Explorer9+

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Firefox Android9+Safari iOS2+Chrome Android18+WebView Android1+Samsung Internet1.0+Opera Android12+

List of event handler content attributes

| Attribute             | Element(s)                    | Description                                                                  | Value                                           |
|-----------------------|-------------------------------|------------------------------------------------------------------------------|-------------------------------------------------|
| <b>onauxclick</b>     | <a href="#">HTML elements</a> | <a href="#">auxclick</a> event handler                                       | <a href="#">Event handler content attribute</a> |
| <b>onafterprint</b>   | <a href="#">body</a>          | <a href="#">afterprint</a> event handler for <a href="#">Window</a> object   | <a href="#">Event handler content attribute</a> |
| <b>onbeforeprint</b>  | <a href="#">body</a>          | <a href="#">beforeprint</a> event handler for <a href="#">Window</a> object  | <a href="#">Event handler content attribute</a> |
| <b>onbeforeunload</b> | <a href="#">body</a>          | <a href="#">beforeunload</a> event handler for <a href="#">Window</a> object | <a href="#">Event handler content attribute</a> |
| <b>onblur</b>         | <a href="#">HTML</a>          | <a href="#">blur</a> event handler                                           | <a href="#">Event handler</a>                   |

| Attribute                | Element(s)                                                | Description                                   | Value                                                              |
|--------------------------|-----------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------|
| <b>oncancel</b>          | <a href="#">elements</a><br><a href="#">HTML elements</a> | <a href="#">cancel</a> event handler          | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncanplay</b>         | <a href="#">HTML elements</a>                             | <a href="#">canplay</a> event handler         | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncanplaythrough</b>  | <a href="#">HTML elements</a>                             | <a href="#">canplaythrough</a> event handler  | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onchange</b>          | <a href="#">HTML elements</a>                             | <a href="#">change</a> event handler          | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onclick</b>           | <a href="#">HTML elements</a>                             | <a href="#">click</a> event handler           | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onclose</b>           | <a href="#">HTML elements</a>                             | <a href="#">close</a> event handler           | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncontextlost</b>     | <a href="#">HTML elements</a>                             | <a href="#">contextlost</a> event handler     | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncontextmenu</b>     | <a href="#">HTML elements</a>                             | <a href="#">contextmenu</a> event handler     | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncontextrestored</b> | <a href="#">HTML elements</a>                             | <a href="#">contextrestored</a> event handler | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncopy</b>            | <a href="#">HTML elements</a>                             | <a href="#">copy</a> event handler            | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncuechange</b>       | <a href="#">HTML elements</a>                             | <a href="#">cuechange</a> event handler       | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>oncut</b>             | <a href="#">HTML elements</a>                             | <a href="#">cut</a> event handler             | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondblclick</b>        | <a href="#">HTML elements</a>                             | <a href="#">dblclick</a> event handler        | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondrag</b>            | <a href="#">HTML elements</a>                             | <a href="#">drag</a> event handler            | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondragend</b>         | <a href="#">HTML elements</a>                             | <a href="#">dragend</a> event handler         | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondragenter</b>       | <a href="#">HTML elements</a>                             | <a href="#">dragenter</a> event handler       | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondragleave</b>       | <a href="#">HTML elements</a>                             | <a href="#">dragleave</a> event handler       | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondragover</b>        | <a href="#">HTML elements</a>                             | <a href="#">dragover</a> event handler        | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondragstart</b>       | <a href="#">HTML elements</a>                             | <a href="#">dragstart</a> event handler       | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondrop</b>            | <a href="#">HTML elements</a>                             | <a href="#">drop</a> event handler            | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ondurationchange</b>  | <a href="#">HTML elements</a>                             | <a href="#">durationchange</a> event handler  | <a href="#">content attribute</a><br><a href="#">Event handler</a> |

| Attribute               | Element(s)                    | Description                                                                    | Value                                           |
|-------------------------|-------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------|
| <b>onemptied</b>        | <a href="#">HTML elements</a> | <a href="#">emptied</a> event handler                                          | <a href="#">Event handler content attribute</a> |
| <b>onended</b>          | <a href="#">HTML elements</a> | <a href="#">ended</a> event handler                                            | <a href="#">Event handler content attribute</a> |
| <b>onerror</b>          | <a href="#">HTML elements</a> | <a href="#">error</a> event handler                                            | <a href="#">Event handler content attribute</a> |
| <b>onfocus</b>          | <a href="#">HTML elements</a> | <a href="#">focus</a> event handler                                            | <a href="#">Event handler content attribute</a> |
| <b>onformdata</b>       | <a href="#">HTML elements</a> | <a href="#">formdata</a> event handler                                         | <a href="#">Event handler content attribute</a> |
| <b>onhashchange</b>     | <a href="#">body</a>          | <a href="#">hashchange</a> event handler for <a href="#">Window object</a>     | <a href="#">Event handler content attribute</a> |
| <b>oninput</b>          | <a href="#">HTML elements</a> | <a href="#">input</a> event handler                                            | <a href="#">Event handler content attribute</a> |
| <b>oninvalid</b>        | <a href="#">HTML elements</a> | <a href="#">invalid</a> event handler                                          | <a href="#">Event handler content attribute</a> |
| <b>onkeydown</b>        | <a href="#">HTML elements</a> | <a href="#">keydown</a> event handler                                          | <a href="#">Event handler content attribute</a> |
| <b>onkeypress</b>       | <a href="#">HTML elements</a> | <a href="#">keypress</a> event handler                                         | <a href="#">Event handler content attribute</a> |
| <b>onkeyup</b>          | <a href="#">HTML elements</a> | <a href="#">keyup</a> event handler                                            | <a href="#">Event handler content attribute</a> |
| <b>onlanguagechange</b> | <a href="#">body</a>          | <a href="#">languagechange</a> event handler for <a href="#">Window object</a> | <a href="#">Event handler content attribute</a> |
| <b>onload</b>           | <a href="#">HTML elements</a> | <a href="#">load</a> event handler                                             | <a href="#">Event handler content attribute</a> |
| <b>onloadeddata</b>     | <a href="#">HTML elements</a> | <a href="#">loadeddata</a> event handler                                       | <a href="#">Event handler content attribute</a> |
| <b>onloadedmetadata</b> | <a href="#">HTML elements</a> | <a href="#">loadedmetadata</a> event handler                                   | <a href="#">Event handler content attribute</a> |
| <b>onloadstart</b>      | <a href="#">HTML elements</a> | <a href="#">loadstart</a> event handler                                        | <a href="#">Event handler content attribute</a> |
| <b>onmessage</b>        | <a href="#">body</a>          | <a href="#">message</a> event handler for <a href="#">Window object</a>        | <a href="#">Event handler content attribute</a> |
| <b>onmessageerror</b>   | <a href="#">body</a>          | <a href="#">messageerror</a> event handler for <a href="#">Window object</a>   | <a href="#">Event handler content attribute</a> |
| <b>onmousedown</b>      | <a href="#">HTML elements</a> | <a href="#">mousedown</a> event handler                                        | <a href="#">Event handler content attribute</a> |
| <b>onmouseenter</b>     | <a href="#">HTML elements</a> | <a href="#">mouseenter</a> event handler                                       | <a href="#">Event handler content attribute</a> |
| <b>onmouseleave</b>     | <a href="#">HTML elements</a> | <a href="#">mouseleave</a> event handler                                       | <a href="#">Event handler content attribute</a> |
| <b>onmousemove</b>      | <a href="#">HTML</a>          | <a href="#">mousemove</a> event handler                                        | <a href="#">Event handler</a>                   |

| Attribute                        | Element(s)                                                | Description                                                                      | Value                                                              |
|----------------------------------|-----------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------|
| <b>onmouseout</b>                | <a href="#">elements</a><br><a href="#">HTML elements</a> | <a href="#">mouseout</a> event handler                                           | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onmouseover</b>               | <a href="#">HTML elements</a>                             | <a href="#">mouseover</a> event handler                                          | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onmouseup</b>                 | <a href="#">HTML elements</a>                             | <a href="#">mouseup</a> event handler                                            | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onoffline</b>                 | <a href="#">body</a>                                      | <a href="#">offline</a> event handler for <a href="#">Window</a> object          | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>ononline</b>                  | <a href="#">body</a>                                      | <a href="#">online</a> event handler for <a href="#">Window</a> object           | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onpagehide</b>                | <a href="#">body</a>                                      | <a href="#">pagehide</a> event handler for <a href="#">Window</a> object         | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onpageshow</b>                | <a href="#">body</a>                                      | <a href="#">pageshow</a> event handler for <a href="#">Window</a> object         | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onpaste</b>                   | <a href="#">HTML elements</a>                             | <a href="#">paste</a> event handler                                              | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onpause</b>                   | <a href="#">HTML elements</a>                             | <a href="#">pause</a> event handler                                              | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onplay</b>                    | <a href="#">HTML elements</a>                             | <a href="#">play</a> event handler                                               | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onplaying</b>                 | <a href="#">HTML elements</a>                             | <a href="#">playing</a> event handler                                            | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onpopstate</b>                | <a href="#">body</a>                                      | <a href="#">popstate</a> event handler for <a href="#">Window</a> object         | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onprogress</b>                | <a href="#">HTML elements</a>                             | <a href="#">progress</a> event handler                                           | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onratechange</b>              | <a href="#">HTML elements</a>                             | <a href="#">ratechange</a> event handler                                         | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onreset</b>                   | <a href="#">HTML elements</a>                             | <a href="#">reset</a> event handler                                              | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onresize</b>                  | <a href="#">HTML elements</a>                             | <a href="#">resize</a> event handler                                             | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onrejectionhandled</b>        | <a href="#">body</a>                                      | <a href="#">rejectionhandled</a> event handler for <a href="#">Window</a> object | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onscroll</b>                  | <a href="#">HTML elements</a>                             | <a href="#">scroll</a> event handler                                             | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onsecuritypolicyviolation</b> | <a href="#">HTML elements</a>                             | <a href="#">securitypolicyviolation</a> event handler                            | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onseeked</b>                  | <a href="#">HTML elements</a>                             | <a href="#">seeked</a> event handler                                             | <a href="#">content attribute</a><br><a href="#">Event handler</a> |
| <b>onseeking</b>                 | <a href="#">HTML elements</a>                             | <a href="#">seeking</a> event handler                                            | <a href="#">content attribute</a><br><a href="#">Event handler</a> |

| Attribute                   | Element(s)                    | Description                                                                        | Value                                           |
|-----------------------------|-------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------|
| <b>onselect</b>             | <a href="#">HTML elements</a> | <a href="#">select</a> event handler                                               | <a href="#">Event handler content attribute</a> |
| <b>onslotchange</b>         | <a href="#">HTML elements</a> | <a href="#">slotchange</a> event handler                                           | <a href="#">Event handler content attribute</a> |
| <b>onstalled</b>            | <a href="#">HTML elements</a> | <a href="#">stalled</a> event handler                                              | <a href="#">Event handler content attribute</a> |
| <b>onstorage</b>            | <a href="#">body</a>          | <a href="#">storage</a> event handler for <a href="#">Window</a> object            | <a href="#">Event handler content attribute</a> |
| <b>onsubmit</b>             | <a href="#">HTML elements</a> | <a href="#">submit</a> event handler                                               | <a href="#">Event handler content attribute</a> |
| <b>onsuspend</b>            | <a href="#">HTML elements</a> | <a href="#">suspend</a> event handler                                              | <a href="#">Event handler content attribute</a> |
| <b>ontimeupdate</b>         | <a href="#">HTML elements</a> | <a href="#">timeupdate</a> event handler                                           | <a href="#">Event handler content attribute</a> |
| <b>ontoggle</b>             | <a href="#">HTML elements</a> | <a href="#">toggle</a> event handler                                               | <a href="#">Event handler content attribute</a> |
| <b>onunhandledrejection</b> | <a href="#">body</a>          | <a href="#">unhandledrejection</a> event handler for <a href="#">Window</a> object | <a href="#">Event handler content attribute</a> |
| <b>onunload</b>             | <a href="#">body</a>          | <a href="#">unload</a> event handler for <a href="#">Window</a> object             | <a href="#">Event handler content attribute</a> |
| <b>onvolumechange</b>       | <a href="#">HTML elements</a> | <a href="#">volumechange</a> event handler                                         | <a href="#">Event handler content attribute</a> |
| <b>onwaiting</b>            | <a href="#">HTML elements</a> | <a href="#">waiting</a> event handler                                              | <a href="#">Event handler content attribute</a> |
| <b>onwheel</b>              | <a href="#">HTML elements</a> | <a href="#">wheel</a> event handler                                                | <a href="#">Event handler content attribute</a> |

## Element interfaces

*This section is non-normative.*

### List of interfaces for elements

| Element(s)              | Interface(s)                                                      |
|-------------------------|-------------------------------------------------------------------|
| <a href="#">a</a>       | <a href="#">HTMLAnchorElement : HTMLElement</a>                   |
| <a href="#">abbr</a>    | <a href="#">HTMLElement</a>                                       |
| <a href="#">address</a> | <a href="#">HTMLElement</a>                                       |
| <a href="#">area</a>    | <a href="#">HTMLAreaElement : HTMLElement</a>                     |
| <a href="#">article</a> | <a href="#">HTMLElement</a>                                       |
| <a href="#">aside</a>   | <a href="#">HTMLElement</a>                                       |
| <a href="#">audio</a>   | <a href="#">HTMLAudioElement : HTMLMediaElement : HTMLElement</a> |
| <a href="#">b</a>       | <a href="#">HTMLElement</a>                                       |
| <a href="#">base</a>    | <a href="#">HTMLBaseElement : HTMLElement</a>                     |

| Element(s)                 | Interface(s)                                          |
|----------------------------|-------------------------------------------------------|
| <a href="#">bdi</a>        | <a href="#">HTMLElement</a>                           |
| <a href="#">bdo</a>        | <a href="#">HTMLElement</a>                           |
| <a href="#">blockquote</a> | <a href="#">HTMLQuoteElement : HTMLElement</a>        |
| <a href="#">body</a>       | <a href="#">HTMLBodyElement : HTMLElement</a>         |
| <a href="#">br</a>         | <a href="#">HTMLBRElement : HTMLElement</a>           |
| <a href="#">button</a>     | <a href="#">HTMLButtonElement : HTMLElement</a>       |
| <a href="#">canvas</a>     | <a href="#">HTMLCanvasElement : HTMLElement</a>       |
| <a href="#">caption</a>    | <a href="#">HTMLTableCaptionElement : HTMLElement</a> |
| <a href="#">cite</a>       | <a href="#">HTMLElement</a>                           |
| <a href="#">code</a>       | <a href="#">HTMLElement</a>                           |
| <a href="#">col</a>        | <a href="#">HTMLTableColElement : HTMLElement</a>     |
| <a href="#">colgroup</a>   | <a href="#">HTMLTableColElement : HTMLElement</a>     |
| <a href="#">data</a>       | <a href="#">HTMLDataElement : HTMLElement</a>         |
| <a href="#">datalist</a>   | <a href="#">HTMLDataListElement : HTMLElement</a>     |
| <a href="#">dd</a>         | <a href="#">HTMLElement</a>                           |
| <a href="#">del</a>        | <a href="#">HTMLModElement : HTMLElement</a>          |
| <a href="#">details</a>    | <a href="#">HTMLDetailsElement : HTMLElement</a>      |
| <a href="#">dfn</a>        | <a href="#">HTMLElement</a>                           |
| <a href="#">dialog</a>     | <a href="#">HTMLDialogElement : HTMLElement</a>       |
| <a href="#">div</a>        | <a href="#">HTMLDivElement : HTMLElement</a>          |
| <a href="#">dl</a>         | <a href="#">HTMLDLListElement : HTMLElement</a>       |
| <a href="#">dt</a>         | <a href="#">HTMLElement</a>                           |
| <a href="#">em</a>         | <a href="#">HTMLElement</a>                           |
| <a href="#">embed</a>      | <a href="#">HTMLEmbedElement : HTMLElement</a>        |
| <a href="#">fieldset</a>   | <a href="#">HTMLFieldSetElement : HTMLElement</a>     |
| <a href="#">figcaption</a> | <a href="#">HTMLElement</a>                           |
| <a href="#">figure</a>     | <a href="#">HTMLElement</a>                           |
| <a href="#">footer</a>     | <a href="#">HTMLElement</a>                           |
| <a href="#">form</a>       | <a href="#">HTMLFormElement : HTMLElement</a>         |
| <a href="#">h1</a>         | <a href="#">HTMLHeadingElement : HTMLElement</a>      |
| <a href="#">h2</a>         | <a href="#">HTMLHeadingElement : HTMLElement</a>      |
| <a href="#">h3</a>         | <a href="#">HTMLHeadingElement : HTMLElement</a>      |
| <a href="#">h4</a>         | <a href="#">HTMLHeadingElement : HTMLElement</a>      |
| <a href="#">h5</a>         | <a href="#">HTMLHeadingElement : HTMLElement</a>      |
| <a href="#">h6</a>         | <a href="#">HTMLHeadingElement : HTMLElement</a>      |
| <a href="#">head</a>       | <a href="#">HTMLHeadElement : HTMLElement</a>         |
| <a href="#">header</a>     | <a href="#">HTMLElement</a>                           |
| <a href="#">hgroup</a>     | <a href="#">HTMLElement</a>                           |
| <a href="#">hr</a>         | <a href="#">HTMLHRElement : HTMLElement</a>           |
| <a href="#">html</a>       | <a href="#">HTMLHtmlElement : HTMLElement</a>         |

| Element(s)      | Interface(s)                                       |
|-----------------|----------------------------------------------------|
| <u>i</u>        | <a href="#">HTMLElement</a>                        |
| <u>iframe</u>   | <a href="#">HTMLIFrameElement : HTMLElement</a>    |
| <u>img</u>      | <a href="#">HTMLImageElement : HTMLElement</a>     |
| <u>input</u>    | <a href="#">HTMLInputElement : HTMLElement</a>     |
| <u>ins</u>      | <a href="#">HTMLModElement : HTMLElement</a>       |
| <u>kbd</u>      | <a href="#">HTMLElement</a>                        |
| <u>label</u>    | <a href="#">HTMLLabelElement : HTMLElement</a>     |
| <u>legend</u>   | <a href="#">HTMLLegendElement : HTMLElement</a>    |
| <u>li</u>       | <a href="#">HTMLListElement : HTMLElement</a>      |
| <u>link</u>     | <a href="#">HTMLLinkElement : HTMLElement</a>      |
| <u>main</u>     | <a href="#">HTMLElement</a>                        |
| <u>map</u>      | <a href="#">HTMLMapElement : HTMLElement</a>       |
| <u>mark</u>     | <a href="#">HTMLElement</a>                        |
| <u>menu</u>     | <a href="#">HTMLMenuElement : HTMLElement</a>      |
| <u>meta</u>     | <a href="#">HTMLMetaElement : HTMLElement</a>      |
| <u>meter</u>    | <a href="#">HTMLMeterElement : HTMLElement</a>     |
| <u>nav</u>      | <a href="#">HTMLElement</a>                        |
| <u>noscript</u> | <a href="#">HTMLElement</a>                        |
| <u>object</u>   | <a href="#">HTMLObjectElement : HTMLElement</a>    |
| <u>ol</u>       | <a href="#">HTMLListElement : HTMLElement</a>      |
| <u>optgroup</u> | <a href="#">HTMLOptGroupElement : HTMLElement</a>  |
| <u>option</u>   | <a href="#">HTMLOptionElement : HTMLElement</a>    |
| <u>output</u>   | <a href="#">HTMLOutputElement : HTMLElement</a>    |
| <u>p</u>        | <a href="#">HTMLParagraphElement : HTMLElement</a> |
| <u>param</u>    | <a href="#">HTMLParamElement : HTMLElement</a>     |
| <u>picture</u>  | <a href="#">HTMLPictureElement : HTMLElement</a>   |
| <u>pre</u>      | <a href="#">HTMLPreElement : HTMLElement</a>       |
| <u>progress</u> | <a href="#">HTMLProgressElement : HTMLElement</a>  |
| <u>q</u>        | <a href="#">HTMLQuoteElement : HTMLElement</a>     |
| <u>rp</u>       | <a href="#">HTMLElement</a>                        |
| <u>rt</u>       | <a href="#">HTMLElement</a>                        |
| <u>ruby</u>     | <a href="#">HTMLElement</a>                        |
| <u>s</u>        | <a href="#">HTMLElement</a>                        |
| <u>samp</u>     | <a href="#">HTMLElement</a>                        |
| <u>script</u>   | <a href="#">HTMLScriptElement : HTMLElement</a>    |
| <u>section</u>  | <a href="#">HTMLElement</a>                        |
| <u>select</u>   | <a href="#">HTMLSelectElement : HTMLElement</a>    |
| <u>slot</u>     | <a href="#">HTMLSlotElement : HTMLElement</a>      |
| <u>small</u>    | <a href="#">HTMLElement</a>                        |
| <u>source</u>   | <a href="#">HTMLSourceElement : HTMLElement</a>    |

| Element(s)                      | Interface(s)                                                                  |
|---------------------------------|-------------------------------------------------------------------------------|
| <a href="#">span</a>            | <a href="#">HTMLSpanElement : HTMLElement</a>                                 |
| <a href="#">strong</a>          | <a href="#">HTMLElement</a>                                                   |
| <a href="#">style</a>           | <a href="#">HTMLStyleElement : HTMLElement</a>                                |
| <a href="#">sub</a>             | <a href="#">HTMLElement</a>                                                   |
| <a href="#">summary</a>         | <a href="#">HTMLElement</a>                                                   |
| <a href="#">sup</a>             | <a href="#">HTMLElement</a>                                                   |
| <a href="#">table</a>           | <a href="#">HTMLTableElement : HTMLElement</a>                                |
| <a href="#">tbody</a>           | <a href="#">HTMLTableSectionElement : HTMLElement</a>                         |
| <a href="#">td</a>              | <a href="#">HTMLTableCellElement : HTMLElement</a>                            |
| <a href="#">template</a>        | <a href="#">HTMLTemplateElement : HTMLElement</a>                             |
| <a href="#">textarea</a>        | <a href="#">HTMLTextAreaElement : HTMLElement</a>                             |
| <a href="#">tfoot</a>           | <a href="#">HTMLTableSectionElement : HTMLElement</a>                         |
| <a href="#">th</a>              | <a href="#">HTMLTableCellElement : HTMLElement</a>                            |
| <a href="#">thead</a>           | <a href="#">HTMLTableSectionElement : HTMLElement</a>                         |
| <a href="#">time</a>            | <a href="#">HTMLTimeElement : HTMLElement</a>                                 |
| <a href="#">title</a>           | <a href="#">HTMLTitleElement : HTMLElement</a>                                |
| <a href="#">tr</a>              | <a href="#">HTMLTableRowElement : HTMLElement</a>                             |
| <a href="#">track</a>           | <a href="#">HTMLTrackElement : HTMLElement</a>                                |
| <a href="#">u</a>               | <a href="#">HTMLElement</a>                                                   |
| <a href="#">ul</a>              | <a href="#">HTMLULListElement : HTMLElement</a>                               |
| <a href="#">var</a>             | <a href="#">HTMLElement</a>                                                   |
| <a href="#">video</a>           | <a href="#">HTMLVideoElement : HTMLMediaElement : HTMLElement</a>             |
| <a href="#">wbr</a>             | <a href="#">HTMLElement</a>                                                   |
| <a href="#">custom elements</a> | supplied by the element's author (inherits from <a href="#">HTMLElement</a> ) |

## All interfaces

*This section is non-normative.*

- [AudioTrack](#)
- [AudioTrackList](#)
- [BarProp](#)
- [BeforeUnloadEvent](#)
- [BroadcastChannel](#)
- [CanvasGradient](#)
- [CanvasPattern](#)
- [CanvasRenderingContext2D](#)
- [CloseEvent](#)
- [CustomElementRegistry](#)
- [DOMParser](#)
- [DOMStringList](#)
- [DOMStringMap](#)

- [DataTransfer](#)
- [DataTransferItem](#)
- [DataTransferItemList](#)
- [DedicatedWorkerGlobalScope](#)
- [Document](#), partial 1 1
- [DragEvent](#)
- [ElementInternals](#)
- [ErrorEvent](#)
- [EventSource](#)
- [External](#)
- [FormDataEvent](#)
- [HTMLAllCollection](#)
- [HTMLAnchorElement](#), partial
- [HTMLAreaElement](#), partial
- [HTMLAudioElement](#)
- [HTMLBRElement](#), partial
- [HTMLBaseElement](#)
- [HTMLBodyElement](#), partial
- [HTMLButtonElement](#)
- [HTMLCanvasElement](#)
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- [HTMLDataListElement](#)
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- [HTMLDialogElement](#)
- [HTMLDirectoryElement](#)
- [HTMLDivElement](#), partial
- [HTMLElement](#)
- [HTMLEmbedElement](#), partial
- [HTMLFieldSetElement](#)
- [HTMLFontElement](#)
- [HTMLFormControlsCollection](#)
- [HTMLFormElement](#)
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- [HTMLHRElement](#), partial
- [HTMLHeadElement](#)
- [HTMLHeadingElement](#), partial
- [HTMLHtmlElement](#), partial
- [HTMLIFrameElement](#), partial
- [HTMLImageElement](#), partial
- [HTMLInputElement](#), partial
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- [HTMLLabelElement](#)
- [HTMLLegendElement](#), partial

- [HTMLLinkElement](#), [partial](#)
- [HTMLMapElement](#)
- [HTMLMarqueeElement](#)
- [HTMLMediaElement](#)
- [HTMLMenuElement](#), [partial](#)
- [HTMLMetaElement](#), [partial](#)
- [HTMLMeterElement](#)
- [HTMLModElement](#)
- [HTMLOLListElement](#), [partial](#)
- [HTMLObjectElement](#), [partial](#)
- [HTMLOptGroupElement](#)
- [HTMLOptionElement](#)
- [HTMLOptionsCollection](#)
- [HTMLOutputElement](#)
- [HTMLParagraphElement](#), [partial](#)
- [HTMLParamElement](#), [partial](#)
- [HTMLPictureElement](#)
- [HTMLPreElement](#), [partial](#)
- [HTMLProgressElement](#)
- [HTMLQuoteElement](#)
- [HTMLScriptElement](#), [partial](#)
- [HTMLSelectElement](#)
- [HTMLSlotElement](#)
- [HTMLSourceElement](#)
- [HTMLSpanElement](#)
- [HTMLStyleElement](#), [partial](#)
- [HTMLTableCaptionElement](#), [partial](#)
- [HTMLTableCellElement](#), [partial](#)
- [HTMLTableColElement](#), [partial](#)
- [HTMLTableElement](#), [partial](#)
- [HTMLTableRowElement](#), [partial](#)
- [HTMLTableSectionElement](#), [partial](#)
- [HTMLTemplateElement](#)
- [HTMLTextAreaElement](#)
- [HTMLTimeElement](#)
- [HTMLTitleElement](#)
- [HTMLTrackElement](#)
- [HTMLULListElement](#), [partial](#)
- [HTMLUnknownElement](#)
- [HTMLVideoElement](#)
- [ChangeEvent](#)
- [HashChangeEvent](#)
- [History](#)
- [ImageBitmap](#)
- [ImageBitmapRenderingContext](#)
- [ImageData](#)

- [Location](#)
- [MediaError](#)
- [MessageChannel](#)
- [MessageEvent](#)
- [MessagePort](#)
- [MimeType](#)
- [MimeTypeArray](#)
- [Navigator](#)
- [OffscreenCanvas](#)
- [OffscreenCanvasRenderingContext2D](#)
- [PageTransitionEvent](#)
- [Path2D](#)
- [Plugin](#)
- [PluginArray](#)
- [PopStateEvent](#)
- [PromiseRejectionEvent](#)
- [RadioNodeList](#)
- [SharedWorker](#)
- [SharedWorkerGlobalScope](#)
- [Storage](#)
- [StorageEvent](#)
- [SubmitEvent](#)
- [TextMetrics](#)
- [TextTrack](#)
- [TextTrackCue](#)
- [TextTrackCueList](#)
- [TextTrackList](#)
- [TimeRanges](#)
- [TrackEvent](#)
- [ValidityState](#)
- [VideoTrack](#)
- [VideoTrackList](#)
- [WebSocket](#)
- [Window, partial](#)
- [Worker](#)
- [WorkerGlobalScope](#)
- [WorkerLocation](#)
- [WorkerNavigator](#)
- [Worklet](#)
- [WorkletGlobalScope](#)

## Events

*This section is non-normative.*

| Event                                                                                                              | Interface             | List of events           | Interesting targets |
|--------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---------------------|
| <i>DOMContentLoaded</i>                                                                                            |                       |                          |                     |
|  MDN                              |                       |                          |                     |
| <a href="#">Window/<br/>DOMContentLoaded_event</a>                                                                 |                       |                          |                     |
| Support in all current engines.                                                                                    |                       |                          |                     |
| Firefox1+Safari3.1+Chrome1+<br>Opera9+Edge79+                                                                      | <a href="#">Event</a> | <a href="#">Document</a> | Fire on<br>finish   |
| Edge (Legacy)12+Internet<br>Explorer9+                                                                             |                       |                          |                     |
| Firefox Android4+Safari<br>iOS2+Chrome<br>Android18+WebView<br>Android37+Samsung<br>Internet1.0+Opera Android10.1+ |                       |                          |                     |
| <i>afterprint</i>                                                                                                  |                       |                          |                     |
|  MDN                              |                       |                          |                     |
| <a href="#">Window/afterprint_event</a>                                                                            |                       |                          |                     |
| Support in all current engines.                                                                                    |                       |                          |                     |
| Firefox6+Safari13+Chrome63+<br>Opera50+Edge79+                                                                     | <a href="#">Event</a> | <a href="#">Window</a>   | Fire on<br>start    |
| Edge (Legacy)12+Internet<br>Explorer9+                                                                             |                       |                          |                     |
| Firefox Android?Safari<br>iOS13+Chrome<br>Android63+WebView<br>Android63+Samsung<br>Internet8.0+Opera Android46+   |                       |                          |                     |
| <i>beforeprint</i>                                                                                                 |                       |                          |                     |
|  MDN                            |                       |                          |                     |
| <a href="#">Window/beforeprint_event</a>                                                                           |                       |                          |                     |
| Support in all current engines.                                                                                    | <a href="#">Event</a> | <a href="#">Window</a>   | Fire on<br>start    |
| Firefox6+Safari13+Chrome63+<br>Opera50+Edge79+                                                                     |                       |                          |                     |
| Edge (Legacy)12+Internet                                                                                           |                       |                          |                     |

| Event                                                                                                                                   | Interface                         | Interesting targets                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|
| Explorer9+                                                                                                                              |                                   |                                                                                     |
| Firefox Android?Safari<br>iOS13+Chrome<br>Android63+WebView<br>Android63+Samsung<br>Internet8.0+Opera Android46+<br><i>beforeunload</i> |                                   |                                                                                     |
|  MDN                                                   |                                   |                                                                                     |
| <a href="#">Window/beforeunload_event</a>                                                                                               |                                   |                                                                                     |
| Support in all current engines.                                                                                                         |                                   |                                                                                     |
| Firefox1+Safari3+Chrome1+<br>Opera12+Edge79+                                                                                            | <a href="#">BeforeUnloadEvent</a> | <a href="#">Window</a>                                                              |
| Edge (Legacy)12+Internet<br>Explorer4+                                                                                                  |                                   | Fired to be shown                                                                   |
| Firefox Android4+Safari<br>iOS1+Chrome<br>Android18+WebView<br>Android1+Samsung<br>Internet1.0+Opera Android12+                         |                                   |                                                                                     |
| <i>blur</i>                                                                                                                             | <a href="#">Event</a>             | <a href="#">Window</a> , elements                                                   |
| <i>cancel</i>                                                                                                                           |                                   | Fired                                                                               |
|  MDN                                                 |                                   |                                                                                     |
| <a href="#">HTMLDialogElement/cancel_event</a>                                                                                          |                                   |                                                                                     |
| Firefox78+SafariNoChrome37+<br>Opera24+Edge79+                                                                                          | <a href="#">Event</a>             | Fired<br>cancels<br><a href="#">dialog</a> elements, <a href="#">input</a> elements |
| Edge (Legacy)NoInternet<br>ExplorerNo                                                                                                   |                                   | Escapes state<br>selection                                                          |
| Firefox AndroidNoSafari<br>iOSNoChrome<br>AndroidNoWebView<br>AndroidNoSamsung<br>InternetNoOpera AndroidNo                             |                                   |                                                                                     |
| <i>change</i>                                                                                                                           | <a href="#">Event</a>             | Form controls                                                                       |
| <a href="#">click</a>                                                                                                                   | <a href="#">PointerEvent</a>      | Elements                                                                            |
|                                                                                                                                         |                                   | Fired<br>values<br>Normal<br>fired<br>behavior<br>from                              |

| Event                                                                                                                           | Interface                                           | Interesting targets                                        |                         |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------|-------------------------|
| <i>close</i>                                                                                                                    |                                                     |                                                            | keybo                   |
|                                                |                                                     |                                                            |                         |
| <a href="#">HTMLDialogElement/close_event</a>                                                                                   |                                                     |                                                            |                         |
| Support in one engine only.                                                                                                     |                                                     |                                                            |                         |
| Firefox No Safari No Chrome 37+<br>Opera 24+ Edge 79+<br>Edge (Legacy) No Internet<br>Explorer No                               | <a href="#">Event</a> or <a href="#">CloseEvent</a> | <a href="#">dialog</a> elements, <a href="#">WebSocket</a> | Fired<br>closed<br>conn |
| Firefox Android No Safari<br>iOS No Chrome<br>Android No WebView<br>Android No Samsung<br>Internet No Opera Android No          |                                                     |                                                            |                         |
| <a href="#">WebSocket/close_event</a>                                                                                           |                                                     |                                                            |                         |
| Support in all current engines.                                                                                                 |                                                     |                                                            |                         |
| Firefox 7+ Safari 5+ Chrome 4+<br>Opera 12.1+ Edge 79+<br>Edge (Legacy) 12+ Internet<br>Explorer 10+                            |                                                     |                                                            |                         |
| Firefox Android 7+ Safari<br>iOS 4.2+ Chrome<br>Android 18+ WebView<br>Android 37+ Samsung<br>Internet 1.0+ Opera Android 12.1+ |                                                     |                                                            |                         |
| <i>connect</i>                                                                                                                  |                                                     |                                                            |                         |
|                                              |                                                     |                                                            |                         |
| <a href="#">SharedWorkerGlobalScope/connect_event</a>                                                                           | <a href="#">MessageEvent</a>                        | <a href="#">SharedWorkerGlobalScope</a>                    | Fired<br>a new          |
| Firefox 29+ Safari No Chrome 4+<br>Opera 10.6+ Edge 79+<br>Edge (Legacy) No Internet<br>Explorer No                             |                                                     |                                                            |                         |
| Firefox Android 29+ Safari<br>iOS No Chrome<br>Android 18+ WebView                                                              |                                                     |                                                            |                         |

| Event                                                                                                             | Interface                                           | Interesting targets                                                                               |
|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Android37+Samsung<br>Internet1.0+Opera Android11+                                                                 |                                                     |                                                                                                   |
| <i>contextlost</i>                                                                                                | <a href="#">Event</a>                               | <a href="#">canvas</a> elements,<br><a href="#">OffscreenCanvas</a> objects                       |
| <i>contextmenu</i>                                                                                                |                                                     | Fired<br><a href="#">Canvas</a><br><a href="#">OffscreenCanvas</a><br>is lost                     |
|                                                                                                                   |                                                     | MDN                                                                                               |
| <a href="#">Element/contextmenu_event</a>                                                                         |                                                     |                                                                                                   |
| Support in all current engines.                                                                                   |                                                     |                                                                                                   |
| Firefox6+Safari3+Chrome1+<br>Opera10.5+Edge79+                                                                    | <a href="#">PointerEvent</a>                        | Elements                                                                                          |
| Edge (Legacy)12+Internet<br>Explorer9+                                                                            |                                                     | Fired<br>their                                                                                    |
| Firefox Android6+Safari<br>iOSNoChrome<br>Android18+WebView<br>Android1+Samsung<br>Internet1.0+Opera Android11.1+ |                                                     |                                                                                                   |
| <i>contextrestored</i>                                                                                            | <a href="#">Event</a>                               | <a href="#">canvas</a> elements,<br><a href="#">OffscreenCanvas</a> objects                       |
| <i>copy</i>                                                                                                       | <a href="#">Event</a>                               | Elements                                                                                          |
| <i>cut</i>                                                                                                        | <a href="#">Event</a>                               | Elements                                                                                          |
| <i>error</i>                                                                                                      |                                                     |                                                                                                   |
|                                                                                                                   |                                                     | Fired<br><a href="#">Canvas</a><br><a href="#">OffscreenCanvas</a><br>is res                      |
|                                                                                                                   |                                                     | Firec                                                                                             |
|                                                                                                                   |                                                     | to th                                                                                             |
|                                                                                                                   |                                                     | Fired                                                                                             |
|                                                                                                                   |                                                     | selec                                                                                             |
|                                                                                                                   |                                                     | the s                                                                                             |
| <a href="#">EventSource/error_event</a>                                                                           |                                                     |                                                                                                   |
| Support in all current engines.                                                                                   | <a href="#">Event</a> or <a href="#">ErrorEvent</a> | Global scope objects, <a href="#">Worker</a><br>objects, elements, networking-<br>related objects |
| Firefox6+Safari5+Chrome6+<br>OperaYesEdge79+                                                                      |                                                     | Fired<br>netw                                                                                     |
| Edge (Legacy)NoInternet<br>ExplorerNo                                                                             |                                                     | error                                                                                             |
| Firefox Android45+Safari                                                                                          |                                                     |                                                                                                   |

| Event                                                                                                   | Interface                       | Interesting targets               |
|---------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------|
| iOS5+Chrome<br>Android18+WebView<br>Android37+Samsung<br>Internet1.0+Opera                              | Android12+                      |                                   |
| <a href="#">WebSocket/error_event</a>                                                                   |                                 |                                   |
| Support in all current engines.                                                                         |                                 |                                   |
| Firefox7+Safari5+Chrome5+<br>Opera12.1+Edge79+                                                          |                                 |                                   |
| Edge (Legacy)12+Internet<br>Explorer10+                                                                 |                                 |                                   |
| Firefox Android7+Safari<br>iOS4.2+Chrome<br>Android18+WebView<br>Android37+Samsung<br>Internet1.0+Opera | Android12.1+                    |                                   |
| <i>focus</i>                                                                                            | <a href="#">Event</a>           | <a href="#">Window</a> , elements |
| <i>formdata</i>                                                                                         |                                 |                                   |
|                       |                                 |                                   |
| <a href="#">HTMLFormElement/formdata_event</a>                                                          |                                 |                                   |
| Support in all current engines.                                                                         |                                 |                                   |
| Firefox72+Safari15+Chrome77+<br>Opera64+Edge79+                                                         | <a href="#">FormDataEvent</a>   | <a href="#">form</a> elements     |
| Edge (Legacy)NoInternet<br>ExplorerNo                                                                   |                                 |                                   |
| Firefox AndroidNoSafari<br>iOS15+Chrome<br>Android77+WebView<br>Android77+Samsung<br>Internet12.0+Opera | Android55+                      |                                   |
| <i>hashchange</i>                                                                                       |                                 |                                   |
|                      |                                 |                                   |
| <a href="#">Window/hashchange_event</a>                                                                 | <a href="#">HashChangeEvent</a> | <a href="#">Window</a>            |
| Support in all current engines.                                                                         |                                 |                                   |
| Firefox3.6+Safari5+Chrome8+                                                                             |                                 |                                   |

| Event                                                                                 | Interface | Interesting targets |
|---------------------------------------------------------------------------------------|-----------|---------------------|
| Opera10.6+Edge79+                                                                     |           |                     |
| Edge (Legacy)12+Internet                                                              |           |                     |
| Explorer8+                                                                            |           |                     |
| Firefox Android4+Safari                                                               |           |                     |
| iOS5+Chrome                                                                           |           |                     |
| Android18+WebView                                                                     |           |                     |
| Android37+Samsung                                                                     |           |                     |
| Internet1.0+Opera Android11+                                                          |           |                     |
| <i>input</i>                                                                          |           |                     |
|  MDN |           |                     |

### [HTMLElement/input\\_event](#)

Support in all current engines.

|                                                                                         |                       |       |
|-----------------------------------------------------------------------------------------|-----------------------|-------|
| Firefox6+Safari3.1+Chrome1+                                                             | <a href="#">Event</a> | Fired |
| Opera11.6+Edge79+                                                                       | <a href="#">Event</a> | value |
| Edge (Legacy)NoInternet                                                                 |                       |       |
| Explorer9+                                                                              |                       |       |
| Firefox Android6+Safari                                                                 |                       |       |
| iOS2+Chrome                                                                             |                       |       |
| Android18+WebView                                                                       |                       |       |
| Android1+Samsung                                                                        |                       |       |
| Internet1.0+Opera Android12+                                                            |                       |       |
| <i>invalid</i>                                                                          |                       |       |
|  MDN |                       |       |

### [HTMLInputElement/invalid\\_event](#)

Support in all current engines.

|                                                                                         |                       |       |
|-----------------------------------------------------------------------------------------|-----------------------|-------|
| Firefox4+Safari5+Chrome10+                                                              | <a href="#">Event</a> | Fired |
| Opera10+Edge79+                                                                         | <a href="#">Event</a> | they  |
| Edge (Legacy)12+Internet                                                                |                       |       |
| Explorer10+                                                                             |                       |       |
| Firefox Android64+Safari                                                                |                       |       |
| iOS5+Chrome                                                                             |                       |       |
| Android18+WebView                                                                       |                       |       |
| Android4+Samsung                                                                        |                       |       |
| Internet4.0+Opera Android12+                                                            |                       |       |
| <i>languagechange</i>                                                                   | <a href="#">Event</a> |       |
|  MDN |                       |       |

| Event                                                                                                               | Interface                    | Interesting targets               |
|---------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------------|
| <a href="#">Window/languagechange_event</a>                                                                         |                              |                                   |
| Support in all current engines.                                                                                     |                              |                                   |
| Firefox32+Safari10.1+Chrome37+<br>Opera24+Edge79+                                                                   |                              |                                   |
| Edge (Legacy)NoInternet<br>ExplorerNo                                                                               |                              |                                   |
| Firefox Android4+Safari<br>iOS10.3+Chrome<br>Android37+WebView<br>Android37+Samsung<br>Internet4.0+Opera Android24+ |                              |                                   |
| <a href="#">WorkerGlobalScope/languagechange_event</a>                                                              |                              |                                   |
| Support in all current engines.                                                                                     |                              |                                   |
| Firefox74+Safari4+Chrome4+<br>Opera11.5+Edge79+                                                                     |                              |                                   |
| Edge (Legacy)12+Internet<br>ExplorerYes                                                                             |                              |                                   |
| Firefox AndroidNoSafari<br>iOS5+Chrome<br>Android40+WebView<br>Android37+Samsung<br>Internet4.0+Opera AndroidYes    |                              |                                   |
| <i>load</i>                                                                                                         | <a href="#">Event</a>        | <a href="#">Window</a> , elements |
| <i>message</i>                                                                                                      |                              |                                   |
| ✓MDN                                                                                                                |                              |                                   |
| <a href="#">BroadcastChannel/message_event</a>                                                                      |                              |                                   |
| Support in all current engines.                                                                                     | <a href="#">MessageEvent</a> |                                   |
| Firefox38+Safari $\nabla$<br>preview+Chrome54+<br>Opera41+Edge79+                                                   |                              |                                   |
| Edge (Legacy)NoInternet                                                                                             |                              |                                   |

| Event                                                | Interface | Interesting targets |
|------------------------------------------------------|-----------|---------------------|
| <u>ExplorerNo</u>                                    |           |                     |
| Firefox Android38+Safari                             |           |                     |
| iOSNoChrome                                          |           |                     |
| Android54+WebView                                    |           |                     |
| Android54+Samsung                                    |           |                     |
| Internet6.0+Opera Android41+                         |           |                     |
| <u>DedicatedWorkerGlobalScope/<br/>message_event</u> |           |                     |
| Support in all current engines.                      |           |                     |
| <u>Firefox3.5+Safari4+Chrome4+</u>                   |           |                     |
| <u>Opera10.6+Edge79+</u>                             |           |                     |
| Edge (Legacy)12+Internet                             |           |                     |
| Explorer10+                                          |           |                     |
| Firefox Android4+Safari                              |           |                     |
| iOS5+Chrome                                          |           |                     |
| Android18+WebView                                    |           |                     |
| Android37+Samsung                                    |           |                     |
| Internet1.0+Opera Android11.5+                       |           |                     |
| <u>EventSource/message_event</u>                     |           |                     |
| Support in all current engines.                      |           |                     |
| <u>Firefox6+Safari5+Chrome6+</u>                     |           |                     |
| <u>OperaYesEdge79+</u>                               |           |                     |
| Edge (Legacy)NoInternet                              |           |                     |
| ExplorerNo                                           |           |                     |
| Firefox Android45+Safari                             |           |                     |
| iOS5+Chrome                                          |           |                     |
| Android18+WebView                                    |           |                     |
| Android37+Samsung                                    |           |                     |
| Internet1.0+Opera Android12+                         |           |                     |
| <u>MessagePort/message_event</u>                     |           |                     |
| Support in all current engines.                      |           |                     |
| <u>Firefox41+Safari5+Chrome4+</u>                    |           |                     |
| <u>Opera10.6+Edge79+</u>                             |           |                     |
| Edge (Legacy)12+Internet                             |           |                     |
| Explorer10+                                          |           |                     |
| Firefox Android41+Safari                             |           |                     |

| Event                                                                                                   | Interface    | Interesting targets |
|---------------------------------------------------------------------------------------------------------|--------------|---------------------|
| iOS4.2+Chrome<br>Android18+WebView<br>Android37+Samsung<br>Internet1.0+Opera                            | Android11.5+ |                     |
| <a href="#">WebSocket/message_event</a>                                                                 |              |                     |
| Support in all current engines.                                                                         |              |                     |
| Firefox7+Safari5+Chrome4+<br>Opera12.1+Edge79+                                                          |              |                     |
| Edge (Legacy)12+Internet<br>Explorer10+                                                                 |              |                     |
| Firefox Android7+Safari<br>iOS4.2+Chrome<br>Android18+WebView<br>Android37+Samsung<br>Internet1.0+Opera | Android12.1+ |                     |
| <a href="#">Window/message_event</a>                                                                    |              |                     |
| Support in all current engines.                                                                         |              |                     |
| Firefox9+Safari4+Chrome60+<br>Opera47+Edge79+                                                           |              |                     |
| Edge (Legacy)12+Internet<br>Explorer8+                                                                  |              |                     |
| Firefox Android9+Safari<br>iOS4+Chrome<br>Android60+WebView<br>Android60+Samsung<br>Internet8.0+Opera   | Android47+   |                     |
| <a href="#">Worker/message_event</a>                                                                    |              |                     |
| Support in all current engines.                                                                         |              |                     |
| Firefox3.5+Safari4+Chrome4+<br>Opera10.6+Edge79+                                                        |              |                     |
| Edge (Legacy)12+Internet<br>Explorer10+                                                                 |              |                     |
| Firefox Android4+Safari<br>iOS5+Chrome<br>Android18+WebView<br>Android4+Samsung                         |              |                     |

| Event                                                                                                             | Interface                    | Interesting targets                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Internet1.0+Opera Android11.5+<br><i>messageerror</i>                                                             |                              |                                                                                                                                                                                                                    |
|  MDN                             |                              |                                                                                                                                                                                                                    |
| <a href="#">BroadcastChannel/<br/>messageerror_event</a>                                                          |                              |                                                                                                                                                                                                                    |
| Support in all current engines.                                                                                   |                              |                                                                                                                                                                                                                    |
| Firefox57+Safari⌚<br>preview+Chrome60+<br>Opera47+Edge79+<br>Edge (Legacy)NoInternet<br>ExplorerNo                |                              |                                                                                                                                                                                                                    |
| Firefox Android57+Safari<br>iOSNoChrome<br>Android60+WebView<br>Android60+Samsung<br>Internet8.0+Opera Android47+ |                              |                                                                                                                                                                                                                    |
| <a href="#">DedicatedWorkerGlobalScope/<br/>messageerror_event</a>                                                | <a href="#">MessageEvent</a> | <a href="#">Window</a> , <a href="#">MessagePort</a> ,<br><a href="#">BroadcastChannel</a> ,<br><a href="#">DedicatedWorkerGlobalScope</a> ,<br><a href="#">Worker</a> ,<br><a href="#">ServiceWorkerContainer</a> |
| Firefox57+SafariNoChrome60+<br>Opera47+Edge79+<br>Edge (Legacy)18Internet<br>ExplorerNo                           |                              | Fired<br>that                                                                                                                                                                                                      |
| Firefox Android57+Safari<br>iOSNoChrome<br>Android60+WebView<br>Android60+Samsung<br>Internet8.0+Opera Android47+ |                              |                                                                                                                                                                                                                    |
| <a href="#">MessagePort/messageerror_event</a>                                                                    |                              |                                                                                                                                                                                                                    |
| Firefox57+SafariNoChrome60+<br>Opera47+Edge79+<br>Edge (Legacy)18Internet<br>ExplorerNo                           |                              |                                                                                                                                                                                                                    |
| Firefox Android57+Safari<br>iOSNoChrome<br>Android60+WebView<br>Android60+Samsung<br>Internet8.0+Opera Android47+ |                              |                                                                                                                                                                                                                    |

| Event                                                                                   | Interface             | Interesting targets |
|-----------------------------------------------------------------------------------------|-----------------------|---------------------|
| <a href="#">Window/messageerror_event</a>                                               |                       |                     |
| Firefox57+SafariNoChrome60+                                                             |                       |                     |
| Opera47+Edge79+                                                                         |                       |                     |
| Edge (Legacy)18Internet                                                                 |                       |                     |
| ExplorerNo                                                                              |                       |                     |
| Firefox Android57+Safari                                                                |                       |                     |
| iOSNoChrome                                                                             |                       |                     |
| Android60+WebView                                                                       |                       |                     |
| Android60+Samsung                                                                       |                       |                     |
| Internet8.0+Opera Android47+                                                            |                       |                     |
| <a href="#">Worker/messageerror_event</a>                                               |                       |                     |
| Firefox57+SafariNoChrome60+                                                             |                       |                     |
| Opera47+Edge79+                                                                         |                       |                     |
| Edge (Legacy)18Internet                                                                 |                       |                     |
| ExplorerNo                                                                              |                       |                     |
| Firefox Android57+Safari                                                                |                       |                     |
| iOSNoChrome                                                                             |                       |                     |
| Android60+WebView                                                                       |                       |                     |
| Android60+Samsung                                                                       |                       |                     |
| Internet8.0+Opera Android47+                                                            |                       |                     |
| <i>offline</i>                                                                          |                       |                     |
|  MDN |                       |                     |
| <a href="#">Window/offline_event</a>                                                    |                       |                     |
| Support in all current engines.                                                         |                       |                     |
| Firefox9+Safari4+Chrome3+                                                               | <a href="#">Event</a> | Fired on network    |
| Opera15+Edge79+                                                                         |                       |                     |
| Edge (Legacy)12+Internet                                                                |                       |                     |
| Explorer9+                                                                              |                       |                     |
| Firefox Android9+Safari                                                                 |                       |                     |
| iOS3+Chrome                                                                             |                       |                     |
| Android18+WebView                                                                       |                       |                     |
| Android37+Samsung                                                                       |                       |                     |
| Internet1.0+Opera Android14+                                                            |                       |                     |
| <i>online</i>                                                                           | <a href="#">Event</a> | Fired on network    |
|  MDN |                       |                     |

| Event | Interface | Interesting targets |
|-------|-----------|---------------------|
|-------|-----------|---------------------|

### [Window/online\\_event](#)

Support in all current engines.

Firefox9+Safari4+Chrome3+

Opera15+Edge79+

Edge (Legacy)12+Internet

Explorer9+

Firefox Android9+Safari

iOS3+Chrome

Android18+WebView

Android37+Samsung

Internet1.0+Opera Android14+

*open*

✓MDN

### [EventSource/open\\_event](#)

Support in all current engines.

Firefox6+Safari5+Chrome6+

OperaYesEdge79+

Edge (Legacy)NoInternet

ExplorerNo

Firefox Android45+Safari

iOS5+Chrome

Android18+WebView

Android37+Samsung

[Event](#)

Internet1.0+Opera Android12+

[EventSource](#), [WebSocket](#)

Fired  
conn

### [WebSocket/open\\_event](#)

Support in all current engines.

Firefox7+Safari5+Chrome4+

Opera12.1+Edge79+

Edge (Legacy)12+Internet

Explorer10+

Firefox Android7+Safari

iOS4.2+Chrome

Android18+WebView

Android37+Samsung

Internet1.0+Opera Android12.1+

| Event | Interface | Interesting targets |
|-------|-----------|---------------------|
|-------|-----------|---------------------|

### *pagehide*



[Window/pagehide\\_event](#)

Support in all current engines.

Firefox6+SafariYesChrome3+

OperaYesEdge79+

Edge (Legacy)12+Internet

Explorer11

Firefox Android6+Safari

iOSYesChrome

Android18+WebView

Android37+Samsung

Internet1.0+Opera AndroidYes

[PageTransitionEvent](#)

[Window](#)

Fired  
in the  
[entry](#)

### *pageshow*



[Window/pageshow\\_event](#)

Support in all current engines.

Firefox6+SafariYesChrome3+

OperaYesEdge79+

Edge (Legacy)12+Internet

Explorer11

Firefox Android6+Safari

iOSYesChrome

Android18+WebView

Android37+Samsung

Internet1.0+Opera AndroidYes

[PageTransitionEvent](#)

[Window](#)

Fired  
in the  
[entry](#)

### *paste*

[Event](#)

Elements

### *popstate*



[Window/popstate\\_event](#)

[PopStateEvent](#)

[Window](#)

Fired  
the c  
form  
conta

Support in all current engines.

Firefox4+Safari5+Chrome5+

Fired  
the s

| Event                          | Interface | Interesting targets |
|--------------------------------|-----------|---------------------|
| Opera11.5+Edge79+              |           |                     |
| Edge (Legacy)12+Internet       |           |                     |
| Explorer10+                    |           |                     |
| Firefox Android4+Safari        |           |                     |
| iOS4.2+Chrome                  |           |                     |
| Android18+WebView              |           |                     |
| Android37+Samsung              |           |                     |
| Internet1.0+Opera Android11.5+ |           |                     |
| <i>readystatechange</i>        |           |                     |
| ✓MDN                           |           |                     |

[Document/  
readystatechange\\_event](#)

Support in all current engines.

Firefox4+Safari4+Chrome1+ [Event](#)

[Document](#)

Fired  
parsi  
have

Opera12.1+Edge79+

Edge (Legacy)12+Internet

Explorer4+

Firefox Android4+Safari

iOS3+Chrome

Android18+WebView

Android37+Samsung

Internet1.0+Opera Android12.1+

*rejectionhandled*

[PromiseRejectionEvent](#) Global scope objects

Fired  
previ  
beco

*reset*

✓MDN

[HTMLFormElement/reset\\_event](#)

Support in all current engines.

Firefox6+Safari4+Chrome1+ [Event](#)

[form](#) elements

Fired

Opera12.1+Edge79+

Edge (Legacy)12+Internet

Explorer9+

Firefox Android6+Safari

iOS3+Chrome

Android18+WebView

Android37+Samsung

Internet1.0+Opera Android12.1+

| Event                                            | Interface                                                                               | Interesting targets           |
|--------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------|
| <i>securitypolicyviolation</i>                   | <a href="#">Event</a>                                                                   | Elements                      |
| <i>select</i>                                    | <a href="#">Event</a>                                                                   | Form controls                 |
| <i>slotchange</i>                                |                                                                                         | by the selected slot          |
|                                                  |  MDN   |                               |
| <a href="#">HTMLSlotElement/slotchange_event</a> |                                                                                         |                               |
| Support in all current engines.                  |                                                                                         |                               |
| Firefox63+Safari10.1+Chrome53+                   | <a href="#">Event</a>                                                                   | <a href="#">slot</a> elements |
| Opera40+Edge79+                                  |                                                                                         | node                          |
| Edge (Legacy)NoInternet                          |                                                                                         |                               |
| ExplorerNo                                       |                                                                                         |                               |
| Firefox Android63+Safari                         |                                                                                         |                               |
| iOS10.3+Chrome                                   |                                                                                         |                               |
| Android53+WebView                                |                                                                                         |                               |
| Android53+Samsung                                |                                                                                         |                               |
| Internet6.0+Opera Android41+                     |                                                                                         |                               |
| <i>storage</i>                                   |                                                                                         |                               |
|                                                  |  MDN |                               |
| <a href="#">Window/storage_event</a>             |                                                                                         |                               |
| Support in all current engines.                  |                                                                                         |                               |
| Firefox45+Safari4+Chrome1+                       | <a href="#">StorageEvent</a>                                                            | <a href="#">Window</a>        |
| Opera15+Edge79+                                  |                                                                                         | correct session               |
| Edge (Legacy)15+Internet                         |                                                                                         |                               |
| Explorer9+                                       |                                                                                         |                               |
| Firefox Android45+Safari                         |                                                                                         |                               |
| iOS4+Chrome                                      |                                                                                         |                               |
| Android18+WebView                                |                                                                                         |                               |
| Android37+Samsung                                |                                                                                         |                               |
| Internet1.0+Opera Android14+                     |                                                                                         |                               |
| <i>submit</i>                                    |                                                                                         |                               |
|                                                  |  MDN |                               |
| <a href="#">SubmitEvent</a>                      |                                                                                         | <a href="#">form</a> elements |
| <a href="#">HTMLFormElement/submit_event</a>     |                                                                                         | Fire                          |

| Event                                                                                                                                             | Interface                                                  | Interesting targets |
|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------------|
| Support in all current engines.                                                                                                                   |                                                            |                     |
| Firefox1+Safari3+Chrome1+<br>Opera8+Edge79+<br>Edge (Legacy)12+Internet<br>Explorer9+                                                             |                                                            |                     |
| Firefox Android4+Safari<br>iOS1+Chrome<br>Android18+WebView<br>Android1+Samsung<br>Internet1.0+Opera Android10.1+<br><i>toggle</i>                |                                                            |                     |
|  MDN                                                             |                                                            |                     |
| <a href="#">HTMLDetailsElement/</a><br><a href="#">toggle_event</a>                                                                               |                                                            |                     |
| Support in all current engines.                                                                                                                   |                                                            |                     |
| Firefox49+Safari10.1+Chrome36+ <a href="#">Event</a><br>Opera23+Edge79+<br>Edge (Legacy)NoInternet<br>ExplorerNo                                  | <a href="#">details</a> element                            | Fired or clo        |
| Firefox Android49+Safari<br>iOS10.3+Chrome<br>Android36+WebView<br>Android37+Samsung<br>Internet3.0+Opera Android24+<br><i>unhandledrejection</i> |                                                            |                     |
|  MDN                                                           |                                                            |                     |
| <a href="#">Window/</a><br><a href="#">unhandledrejection_event</a>                                                                               |                                                            |                     |
| Support in all current engines.                                                                                                                   |                                                            |                     |
| Firefox69+Safari11+Chrome49+<br>Opera36+Edge79+<br>Edge (Legacy)NoInternet<br>ExplorerNo                                                          | <a href="#">PromiseRejectionEvent</a> Global scope objects | Fired rejec         |
| Firefox Android68+Safari<br>iOS11.3+Chrome<br>Android49+WebView                                                                                   |                                                            |                     |

| Event                                                                                                             | Interface             | Interesting targets      |
|-------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|
| Android49+Samsung<br>Internet5.0+Opera<br><i>unload</i>                                                           |                       |                          |
|  MDN                             |                       |                          |
| <a href="#">Window/unload_event</a>                                                                               |                       |                          |
| Support in all current engines.                                                                                   |                       |                          |
| Firefox1+Safari3+Chrome1+<br>Opera4+Edge79+                                                                       | <a href="#">Event</a> | <a href="#">Window</a>   |
| Edge (Legacy)12+Internet<br>Explorer4+                                                                            |                       | Fired<br>going           |
| Firefox Android4+Safari<br>iOS1+Chrome<br>Android18+WebView<br>Android1+Samsung<br>Internet1.0+Opera Android10.1+ |                       |                          |
| <i>visibilitychange</i>                                                                                           | <a href="#">Event</a> | <a href="#">Document</a> |
|                                                                                                                   |                       | Fired<br>beco<br>[PAC]   |

See also [media element events](#) and [drag-and-drop events](#).

## HTTP headers

*This section is non-normative.*

The following HTTP request headers are defined by this specification:

- ['Last-Event-ID'](#)
- ['Ping-From'](#)
- ['Ping-To'](#)

The following HTTP response headers are defined by this specification:

- ['Cross-Origin-Embedder-Policy'](#)
- ['Cross-Origin-Embedder-Policy-Report-Only'](#)
- ['Cross-Origin-Opener-Policy'](#)
- ['Cross-Origin-Opener-Policy-Report-Only'](#)
- ['Origin-Agent-Cluster'](#)
- ['Refresh'](#)
- ['X-Frame-Options'](#)

## MIME types

*This section is non-normative.*

The following MIME types are mentioned in this specification:

### ***application/atom+xml***

Atom [\[ATOM\]](#)

### ***application/ecmascript***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

### ***application/javascript***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

### ***application/json***

JSON [\[JSON\]](#)

### ***application/x-ecmascript***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

### ***application/x-javascript***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

### ***application/octet-stream***

Generic binary data [\[RFC2046\]](#)

### **application/microdata+json**

Microdata as JSON

### ***application/rss+xml***

RSS

### **application/x-www-form-urlencoded**

Form submission

### **application/xhtml+xml**

HTML

### ***application/xml***

XML [\[XML\]](#) [\[RFC7303\]](#)

### ***image/gif***

GIF images [\[GIF\]](#)

### ***image/jpeg***

JPEG images [\[JPEG\]](#)

***image/png***

PNG images [\[PNG\]](#)

***image/svg+xml***

SVG images [\[SVG\]](#)

***multipart/form-data***

Form submission [\[RFC7578\]](#)

***multipart/mixed***

Generic mixed content [\[RFC2046\]](#)

***multipart/x-mixed-replace***

Streaming server push

***text/css***

CSS [\[CSS\]](#)

***text/ecmascript***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

***text/event-stream***

Server-sent event streams

***text/javascript***

JavaScript [\[JAVASCRIPT\]](#)

***text/javascript1.0***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

***text/javascript1.1***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

***text/javascript1.2***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

***text/javascript1.3***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

***text/javascript1.4***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

***text/javascript1.5***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

***text/jscript***

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

**text/json**

JSON (legacy type)

**text/livescript**

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

**text/plain**

Generic plain text [\[RFC2046\]](#) [\[RFC3676\]](#)

**text/html**

HTML

**text/ping**

Hyperlink auditing

**text/uri-list**

List of URLs [\[RFC2483\]](#)

**text/vcard**

vCard [\[RFC6350\]](#)

**text/vtt**

WebVTT [\[WEBVTT\]](#)

**text/x-ecmascript**

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

**text/x-javascript**

JavaScript (legacy type) [\[JAVASCRIPT\]](#)

**text/xml**

XML [\[XML\]](#) [\[RFC7303\]](#)

**video/mp4**

MPEG-4 video [\[RFC4337\]](#)

**video/mpeg**

MPEG video [\[RFC2046\]](#)

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