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# **HTML5 Cookbook**



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# HTML5 Cookbook

*Christopher Schmitt and Kyle Simpson*

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**HTML5 Cookbook**

by Christopher Schmitt and Kyle Simpson

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# Preface

Your first few paragraphs should introduce the book to the reader by describing, what this book is about, interesting points about this technology, things to bear in mind, etc.

## Audience

While it would probably suffice to say that this book is for any person interested in learning about...

## Assumptions This Book Makes

So on and so forth about what expertise and/or technical savvy is necessary to utilize or appreciate, etc.

## Contents of This Book

The most common presentation of this section lists each chapter with brief descriptions. Some others describe each part or provide a narrative explanation of the book. For example:

Part I describes...

[Chapter 1](#) covers...

## Conventions Used in This Book

The following typographical conventions are used in this book:

### *Plain text*

Indicates menu titles, menu options, menu buttons, and keyboard accelerators (such as Alt and Ctrl).

### *Italic*

Indicates new terms, URLs, email addresses, filenames, file extensions, pathnames, directories, and Unix utilities.

### **Constant width**

Indicates commands, options, switches, variables, attributes, keys, functions, types, classes, namespaces, methods, modules, properties, parameters, values, objects, events, event handlers, XML tags, HTML tags, macros, the contents of files, or the output from commands.

### **Constant width bold**

Shows commands or other text that should be typed literally by the user.

### *Constant width italic*

Shows text that should be replaced with user-supplied values.



This icon signifies a tip, suggestion, or general note.



This icon indicates a warning or caution.

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## **Acknowledgments**

Use this section to thank reviewer and other people and organizations that assisted with the book's creation.

# Fundamental Syntax & Semantics

*Emily Lewis*

## Introduction

This chapter is designed to get you up and running with HTML5 basics.

Covering the fundamental recipes, from declaring the DOCTYPE and character set to dealing with ambiguities of the new HTML5 semantics, this chapter helps lay the groundwork for the rest of the book.

## Specifying the DOCTYPE

### Problem

You want to create an HTML5 page.

### Solution

Specify the HTML5 DOCTYPE at the very beginning of your page:

```
<!DOCTYPE html>
<html>
  <head>
    <title>HTML5, for Fun &amp; Profit</title>
  </head>
  <body>
    </body>
</html>
```



Note that the DOCTYPE is not case-sensitive. Feel free to go CaMeL cAsE with the characters..

## Discussion

The Document Type Definition, or DOCTYPE, tells browsers and validators what version of HTML the page is written in. Previous versions of HTML specified the version number, such as the DOCTYPE for XHTML 1.0 Strict:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.
```

With HTML5, the version is dropped from the DOCTYPE. This allows HTML5 to be backwards compatible in terms of syntax and, hopefully, makes the transition to HTML5 easier.

Let's say you have a site that is valid HTML 4.0, but you want to transition to HTML5. Start with just the DOCTYPE change, and you not only have a valid site, but also a *valid HTML5* site.

Additionally, all browsers recognize the shortened DOCTYPE and render in strict standards mode.



There are some elements that have changed between HTML4 and HTML5, so some now removed or deprecated parts of your HTML4 document.

For example, `<center>` might not *technically* validate as HTML5.

## See Also

The W3C Working Draft discussion on differences between HTML 4 and HTML5 includes DOCTYPE at <http://www.w3.org/TR/html5-diff/#doctype>.

# Specifying the Character Set

## Problem

You need to define the character encoding of your web page.

## Solution

In your document head, add a `meta` declaration for the character set:

```
<meta charset="UTF-8" />
```

## Discussion

*Character encoding* tells browsers and validators what set of characters to use when rendering web pages.

If you do not declare the character set in your HTML, browsers first try to determine the character set from your server's HTTP response headers (specifically, the "Content-Type" header).

The character set declared in the response headers is generally taken in preference over the character set specified in your document, and is thus the preferred method.

However, if you cannot control what headers your server sends, declaring the character set in your HTML document is the next best option.

If a character set is neither declared in the document nor in the response headers, the browser might choose one for you and it *may* be the wrong one for your site's needs.

This could not only cause issues with rendering, but also poses a security risk.



Several years ago, a cross-site scripting vulnerability was discovered at Google that demonstrates the importance of character encoding: <http://shiflett.org/blog/2005/dec/googles-xss-vulnerability>

In previous versions of HTML, the character set needed to be declared with additional attributes and values:

```
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
```

But, like the DOCTYPE, HTML5 only needs the minimum information required by browsers. Again, this helps with backwards compatibility and makes it easier for authors to implement.

## Special Characters

In this recipe, the page was specified to Unicode (UTF-8) because it is a versatile encoding that covers most web builders' needs. Sometimes, though, you need to include a character that is outside the encoding.



A great resource for character entities is at <http://www.digitalmediamuncture.com/reference/entity/>. It includes the numeric, named and Unicode references for many of the more common characters allowed in HTML.

For these characters, you specify them with a Numeric Character Reference (NCR) or as a named entity in order to help browsers render them correctly. If you wanted a copyright symbol, for example, you could include it in your HTML as an NCR:

```
&#169;
```

Or you could include it as a named entity:

```
&copy;
```

## See Also

Mark Pilgrim's "Dive Into HTML5" discussion about character encoding at <http://diveintohtml5.org/semantics.html#encoding>.

# Specifying the Language

## Problem

You want to specify the primary language of your web page.

## Solution

Add the `lang` attribute and appropriate value to your opening `html` element:

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

## Discussion

Browsers, screen readers and other user agents use the `lang` attribute to know what language the content should be interpreted in. The example above specifies English via the `en` value.

Declaring a document's primary language isn't a requirement for HTML5 or any of the previous versions, for that matter. It is, however, a good practice for both usability and accessibility.

## See Also

Mark Pilgrim's "Dive Into Accessibility" discussion about identifying your document language at [http://diveintoaccessibility.org/day\\_7\\_identifying\\_your\\_language.html](http://diveintoaccessibility.org/day_7_identifying_your_language.html)

# Optimizing scripts and links

## Problem

You want to reference JavaScript and include links to external CSS files in your web page as simply as possible.

## Solution

Include `script` and `link` declarations, but *without* the `type` attribute:

```
<link rel="stylesheet" href="styles.css" />
<script src="scripts.js"></script>
```

## Discussion

HTML5 requires only the minimum amount of information needed for user agents. In previous versions of HTML, both CSS `links` and `script` required the `type` attribute to indicate the language. If you forgot to include `type`, though, most browsers assumed the correct value.

Makes sense, since there is really only one standard scripting language and only one styling language for the web right now. HTML5 makes `type` *officially* optional, but still validates older documents that do include the attribute.

## See Also

The W3C Working Draft discussion on differences between HTML 4 and HTML5 includes changed attributes at <http://www.w3.org/TR/html5-diff/#changed-attributes>.

# Adding Document Structure With HTML5's New Elements

## Problem

You want to define your document structure with the new `header`, `footer`, `nav`, `aside`, `section` and `article` elements.

## Solution

Examine your content and document structure to determine which of the new elements work with your page:

`<header>`

Is used to contain the headline(s) for a page and/or `section`. It can also contain supplemental information such as logos and navigational aids.

`<footer>`

Contains information about a page and/or `section`, such as who wrote it, links to related information and copyright statements.

`<nav>`

Contains the *major* navigation links for a page and, while not a requirement, is often contained by `header`.

`<aside>`

Contains information that is *related* to the surrounding content but also exists *independently*, such as a sidebar or pull-quotes.

## <section>

Is the most generic of the new structural elements, containing content that can be grouped thematically or is related.

## <article>

Is used for self-contained content that could be consumed independent of the page as a whole, such as a blog entry.

A simple blog structure, with a headline, navigation, sidebar, blog posts and footer (see [Figure 1-2](#)) could be marked up in HTML5 as:

```
<header>
    <h1><abbr title="Hypertext Markup Language">HTML</abbr>5, for Fun & Profit</h1>
    <nav>
        <ul>
            <li><a href="/Archive/">Archive</a></li>
            <li><a href="/About/">About</a></li>
        </ul>
    </nav>
</header>
<article>
    <h2><code>nav</code> Isn't for <em>All</em> Links</h2>
    <p>Though the <code>nav</code> element often contains links, that doesn't mean that <em>all</em> lin
</article>
<article>
    <h2>You've Got the <code>DOCTYPE</code>. Now What?</h2>
    <p>HTML5 isn't an all or nothing proposition. You can pick and choose what works best for you. So or
</article>
<aside>
    <h2>HTML5 Elsewhere</h2>
    <p>Feed your HTML5 fix with resources from our partners:</p>
    <ul>
        <li><a href="http://lovinghtml5.com">Loving HTML5</a></li>
        <li><a href="http://semanticsally.com">Semantic Sally</a></li>
    </ul>
</aside>
<footer>
    <p>Copyright &copy; 2011 <a href="http://html5funprofit.com">HTML5, for Fun & Profit</a>. All rig
</footer>
```

And, with the right CSS and supporting HTML, this markup could render on the browser as shown in [Figure 1-1](#).

## Discussion

These new structural elements were developed based on actual practices. A review of over a billion web pages (see <http://code.google.com/webstats/>) revealed the naming conventions markup authors were already using to structure and describe their content via `class` and `id`, including:

- Header
- Footer

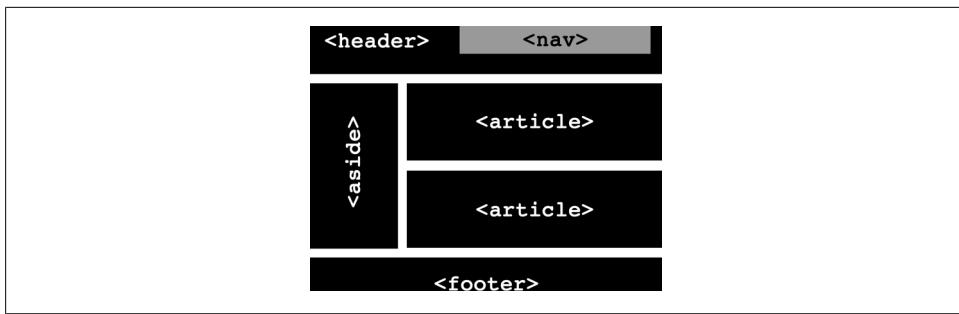


Figure 1-1. Sample rendering of a simple blog structure using HTML5’s new elements.

- Nav

The new elements in HTML5 simply attempt to reflect what authors are already doing.

## Structural Elements

Using these structural elements helps you make your markup more semantic, but they also help define the main landmarks in the document.

Consider how important it is for screen reader users and folks who navigate with the keyboard to be able to skip to different areas of the page, like the navigation.

Previously, we’ve tried to provide such functionality via “skip links” and shortcuts, but HTML5 establishes formal landmark elements that can be used.

That said, this is still a hypothetical.

As of this writing, no browsers or assistive technologies reference the structural elements for any navigational purposes.

In fact, the Web Accessibility Initiative’s Accessible Rich Internet Applications (WAI-ARIA) specification already addresses how to use HTML5 with ARIA landmark roles (see [Chapter 2](#)) for this very purpose.

## When to Use Structural Elements

How do you know when to use these new elements?

Again, focus on your content and consider the semantics of each element.

For example, most sites have an area considered a “header,” comprised of a logo, maybe the company name and a tagline. And that certainly sounds like a good case for `header`.

You may also have a `section` or `aside` in your document with its own set of headlines and navigation, for which `header` is also completely appropriate.

The same holds true for `footer`. While most pages have content appropriate for the new `footer` element — author, copyrights, related information — `sections`, `articles` and `asides` can feature the same information. And, in turn, can also include `footer`.

Or consider `nav`. You may have many groups of links on your site, some of which are for navigation, while others are external.

But `nav` is only appropriate for *major* site navigation, not search results links or a blog-roll.

## When to Use `div` Elements

As you can see from the blog markup example, the new structural elements can replace many of the non-semantic container `divs` that you may have grown accustomed to using. But `div` still has a place at the HTML5 party.

If you ever need a containing element *strictly for style purposes*, `div` is the element to use. You don't want to use one of the new structural elements just to serve as a hook for your CSS. That is not what semantic markup is about.

Just remember to focus on your content and avoid *unnecessary* use of `div`, such as when another element is more semantic.

For example, if you have a paragraph of text, use the `p` element not `div`. Both give you block-level formatting, but `p` is more semantic for that particular purpose.

## Styling Structural Elements

All of today's browsers render the content contained by these new elements, however some browsers don't recognize them and, as such, treat them like inline elements. This default rendering can cause some serious problems with styling.

Fortunately, it doesn't take much to fix.

The current cast of browsers simply needs to be told to treat the elements as block-level elements:

```
header, footer, nav, article, aside, section {  
    display: block;  
}
```

And with that single CSS declaration, you can happily style the structural elements. Well, almost.

In versions of Internet Explorer (IE) prior to IE9 you have to add a bit of JavaScript to your document so IE recognizes the elements and allow you to style them:

```
<script>  
    document.createElement('header');  
    document.createElement('footer');  
    document.createElement('nav');  
    document.createElement('article');  
    document.createElement('aside');  
    document.createElement('section');  
</script>
```

Any time you add a new HTML5 element to your document, you need to add this document.createElement if you want cooperation from Internet Explorer before version 9. See [Chapter 2](#) for a more detailed discussion on using JavaScript with IE.

## See Also

Script Junkie's article "Using HTML5's New Semantic Tags Today" at <http://msdn.microsoft.com/en-us/scriptjunkie/gg454786>.

# Choosing Between article and section

## Problem

You don't know whether `article` or `section` is the most appropriate element to use on your web page.

## Solution

Focus on your content and the semantic definitions of `article` and `section` ([“Choosing Between article and section” on page 9](#)).

### <article>

`article` can be considered a specialized form of `section`. It is intended for content that could stand on its own, outside of all surrounding content, such as “syndicatable” content like blog posts.

`article` is suitable for other types of content, including:

- Video and accompanying transcript
- News articles
- Blog comments



Often the name of an article or a blog post is in the title of the URI. If that's the case with a page you are working on, that content should be wrapped in an `article` element.

As you saw in the code example in [“Choosing Between article and section” on page 9](#), we used `article` to contain the individual blog posts:

```
<article>
  <h2><code>nav</code> Isn't for <em>All</em> Links</h2>
  <p>Though the <code>nav</code> element often contains links, that doesn't mean that <em>all</em> lin
</article>
```

```
<article>
  <h2>You've Got the <code>DOCTYPE</code>. Now What?</h2>
  <p>HTML5 isn't an all or nothing proposition. You can pick and choose what works best for you. So on
</article>
```

## <section>

section, meanwhile, is the most generic of the new structural elements, intended to simply group related content. However, it is *not* a generic container element like `div`. The content it groups must be *related*.

This definition, applied to “Choosing Between article and section” on page 9, could mean the addition of `section` as the parent element for both instances of `article`:

```
<section>
  <article>
    <h2><code>nav</code> Isn't for <em>All</em> Links</h2>
    <p>Though the <code>nav</code> element often contains links, that doesn't mean that <em>all</em>
  </article>
  <article>
    <h2>You've Got the <code>DOCTYPE</code>. Now What?</h2>
    <p>HTML5 isn't an all or nothing proposition. You can pick and choose what works best for you. S
  </article>
</section>
```

This example meets the core criteria for `section`: the grouped content is thematically related.

But, wait! The spec (see <http://www.w3.org/TR/html5/sections.html#the-section-element>) further clarifies:

“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.”

The *document outline* refers to HTML5’s new *sectioning content* model where each of the new structural elements creates its own self-contained outline. This outline is generated by the headings (`h1-h6`) contained in each element (see “Emphasizing Text” on page 15).

So, based on this context, if you want to use `section`, the content *should* have a natural heading.

Given this additional clarification, let’s modify the markup from “Choosing Between article and section” on page 9 to include a heading for `section`:

```
<section>
  <h1>Most Recent Blog Posts</h1>
  <article>
    <h2><code>nav</code> Isn't for <em>All</em> Links</h2>
    <p>Though the <code>nav</code> element often contains links, that doesn't mean that <em>all</em>
  </article>
  <article>
    <h2>You've Got the <code>DOCTYPE</code>. Now What?</h2>
    <p>HTML5 isn't an all or nothing proposition. You can pick and choose what works best for you. S
```

```
</article>
</section>
```

## Discussion

The difference between `section` and `article` can be confusing and, as the spec evolves, the path doesn't seem to be getting much clearer. For the *majority* of use cases, though, considering these guidelines should help:

- Do not use `section` simply as a styling hook. Use `divs` and `spans` instead.
- Do not use `section` if `header`, `footer`, `aside` or `article` is more semantically appropriate (“[Choosing Between article and section](#)” on page 9) for your content.
- Do not use `section` unless it has a natural heading.

## See Also

HTML5 Doctor has a handy flow chart to help choose the right HTML5 structural elements at <http://html5doctor.com/happy-1st-birthday-us/#flowchart>.

## Checking Your Document Outline

### Problem

You want to view your document's content outline.

### Solution

Run your page through the HTML5 Outliner tool: <http://gsnedders.html5.org/outliner/>.

## Discussion

HTML5 has an outline algorithm that calculates the structure of a web document. This algorithm is based on sections defined by the new structural elements.

For the main document outline, `section` and `aside` each introduce a new section in the outline, while the heading(s) within each form the outline content. This is known as *explicit sectioning*.

Let's examine the following markup example:

```
<section>
  <h1>Most Recent Blog Posts</h1>
  <article>
    <h2><code>nav</code> Isn't for <em>All</em> Links</h2>
    <p>Though the <code>nav</code> element often contains links, that doesn't mean that <em>all</em>
```

```
<article>
  <h2>You've Got the <code>DOCTYPE</code>. Now What?</h2>
  <p>HTML5 isn't an all or nothing proposition. You can pick and choose what works best for you. So
  </article>
</section>
```

This markup would generate the following document outline:

1. Most Recent Blog Posts
  - a. nav Isn't for All Links
  - b. You've Got the DOCTYPE. Now What?

### Heading Levels

Regardless of version, headings in HTML are ranked, with **h1** being the highest and **h6** being the lowest.

Before HTML5, this ranking helped structure the document outline. However, with HTML5, the importance of heading rank in determining the outline is trumped by the sectioning elements.

Let's modify the previous example to reflect **h6** as the primary heading of section and **h1** as the primary heading of article:

```
<section>
  <h6>Most Recent Blog Posts</h6>
  <article>
    <h1><code>nav</code> Isn't for <em>All</em> Links</h1>
    <p>Though the <code>nav</code> element often contains links, that doesn't mean that <em>all</em>
  </article>
  <article>
    <h1>You've Got the <code>DOCTYPE</code>. Now What?</h1>
    <p>HTML5 isn't an all or nothing proposition. You can pick and choose what works best for you. So
  </article>
</section>
```

Because HTML5 uses the structural elements **section** and **aside** to know when a new outline section begins (not the headings), we still get the exact same outline as the original example:

1. Most Recent Blog Posts
  - a. nav Isn't for All Links
  - b. You've Got the DOCTYPE. Now What?

### Implicit Sectioning

Since structural elements aren't required in HTML5, heading rank *does* still affect the document structure if sectioning elements aren't used. This is known as *implicit sectioning*. Further, implicit and explicit sectioning can be used together to form the document outline.

An implicit section starts with a new heading and is positioned in the document outline according to that heading's rank in relation to a previous heading. If a heading is a lower rank than its predecessor, it opens a new sub-section in the outline. If a heading is a higher rank, it closes the previous section and opens a new one.

Let's create a new example to see how heading rank supports implicit sections:

```
<section>
  <h1>You've Got the <code>DOCTYPE</code>, Now What?</h1>
  <h2>Simplified <code>link</code>s and <code>script</code>s</h2>
  <p>HTML5's more flexible and simplified syntax ...</p>
  <h2>Block-Level Links</h2>
  <p>With HTML5, <code>a</code>s can contain block ...</p>
  <h3>Looking Back</h3>
  <p>In earlier versions of HTML, you had to ...</p>
  <h2>Add Structure</h2>
  <p>HTML5 gives us several new elements to add ...</p>
</section>
```

This example utilizes heading rank, rather than explicit sectioning elements, to generate the following outline:

1. You've Got the DOCTYPE, Now What?
  - a. Simplified links and scripts
  - b. Block-level Links

Tip #2: Looking Back

  - c. Add Structure

## Why Is This Important?

Knowing what your document outline looks like can help you decide not only which heading levels to use, but also helps you decide which structural elements to use. Remember how `section` should have a natural heading ([“Checking Your Document Outline” on page 11](#))?

Checking your document outline show if you have neglected to include a heading, which may prompt you to reconsider whether that element was the most appropriate for your content.

Additionally, a document outline that accurately reflects your content hierarchy can help users of assistive devices navigate your site.

Unfortunately, no browsers have implemented this outlining yet, nor do any assistive technologies utilize it for navigation.

Still, checking the document outline should be a part of the development process helps significantly when deciding which elements and heading levels to use.

## See Also

For an extremely detailed look at the outline algorithm and sectioning, the Mozilla Developer Network is an excellent resource at [https://developer.mozilla.org/en/Sections\\_and\\_Outlines\\_of\\_an\\_HTML5\\_document](https://developer.mozilla.org/en/Sections_and_Outlines_of_an_HTML5_document).

# Modifying the Document Outline

## Problem

You have a primary page title and tagline marked up with headings (`h1` and `h2`, respectively), but you don't want the tagline included in your document outline.

## Solution

Contain the both headings with the `hgroup` element:

```
<hgroup>
  <h1>HTML5, for Fun & Profit</h1>
  <h2>Tips, Tricks and Resources</h2>
</hgroup>
```

## Discussion

`hgroup` hides all headings, except the highest ranked, from the document outline. In the above example, the only content that would appear in the document outline is “HTML5, for Fun & Profit” from the `h1`.

Even reversing the source order of the two headings still only pulls the highest ranked `h1` content into the document outline:

```
<hgroup>
  <h2>Tips, Tricks and Resources</h2>
  <h1>HTML5, for Fun & Profit</h1>
</hgroup>
```

## See Also

Emily Lewis' in-depth discussion of headings, `hgroup` and the HTML5 outline at <http://ablognotlimited.com/articles/the-beauty-of-semantic-markup-part-3-headings>.

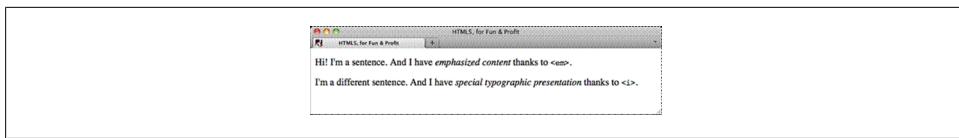


Figure 1-2. Browsers render both the *i* and *em* elements in italics.

## Emphasizing Text

### Problem

You want to add emphasis or emphatic stress to text content.

### Solution

Contain the text to be emphasized with the *em* element:

```
<p>My name is <em>Jane</em>, not John.</p>
```

### Discussion

After looking at this example, you may be wondering what is new here, since *em* has been around since HTML 4. The difference is that HTML5 slightly redefines *em* for text with “emphatic stress,” which I translate as any text that, when spoken, I would verbally emphasize.

### Redefining *<i>*

Another change in HTML5’s text-level semantics is that the *i* element is no longer considered presentational. You can now use *i* to indicate text that is in an alternate voice or mood, or somehow offset from the normal prose.

For example, a taxonomic designation, a technical term, a thought, an idiomatic phrase, or some other text whose typical typographic presentation is italicized:

```
<p>Sally thought to herself, <i>when will IE6 die?</i>.</p>
```

Despite the new semantic distinction, browsers typically render both *em* and *i* in italics (see [Figure 1-2](#)). Of course, you can change the default styling of either element with CSS.

### See Also

HTML5 Doctor's article "The i, b, em, & strong elements" at <http://html5doctor.com/i-b-em-strong-element/>.

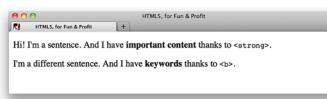


Figure 1-3. Browsers render both the `<b>` and `<strong>` elements in bold.

## Adding Importance to Text

### Problem

You want to indicate a span of text that is important.

### Solution

Contain the important text with the `strong` element:

```
<p><strong>Registration is required</strong> for this event.</p>
```

### Discussion

In previous versions of HTML, `strong` was used to indicate strong emphasis. Now, in HTML5 `strong` indicates importance, such as alerts and warnings.

#### Redefining `<b>`

Much like it's shunned sibling `i`, the `b` element makes a comeback in HTML5. No longer considered a presentational element, `b` is used to stylistically offset text from the normal prose without conveying any extra importance.

For example, `b` could be used for keywords, product names, or other content whose text would typically be unique compared to surrounding text such as a paragraph lead:

```
<p><b>Once upon a time,</b> there was a man who lost his mind.</p>
```

The difference between `strong` and `b` is now more semantically clear, but both are typically rendered in browsers with a heavier font weight (see Figure 1-3). Of course, CSS lets you change the default styling as needed.

### See Also

The author's article "The Beauty of Semantic Markup, Part 2: `<strong>`, `<b>`, `<em>`, `<i>`" at <http://ablognotlimited.com/articles/the-beauty-of-semantic-markup-part-2-strong-b-em-i>.

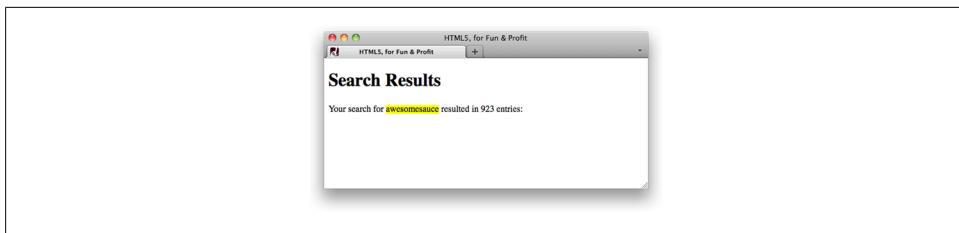


Figure 1-4. Browsers render the `<mark>` element with a yellow background by default.

## Highlighting Text for Reference

### Problem

You want to highlight the search term(s) in a list of search results.

### Solution

Contain the search term with the `mark` element:

```
<p>Your search for <mark>awesomesauce</mark> resulted in 923 entries:</p>
```

### Discussion

`mark` is an entirely new element in HTML5. While the most common scenario for its use is likely for search terms, it can be more broadly used for text that is “marked or highlighted for reference purposes, due to its relevance in another text.”

`mark` adds no additional semantic importance or emphasis to the text it contains, but current browsers (that doesn’t include IE before version 9) do display the content with a yellow background by default (see [Figure 1-4](#)), which you can change with CSS.

### See Also

HTML5 Doctor's article "Draw attention with mark" at <http://html5doctor.com/draw-attention-with-mark/>.

## Marking Up Small Print

### Problem

You want to offset a legal disclaimer and copyright statement as small print.

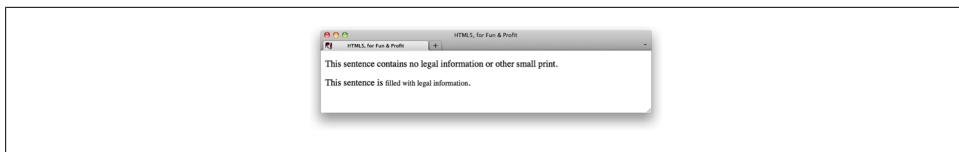


Figure 1-5. The first sentence does not contain the `<small>` element, while the second does. Note the slightly smaller font size in part of the second sentence.

## Solution

Contain the small print content with the `small` element:

```
<p><small>The owner of this blog is not responsible for mind blowage. Please consume at your own risk.</small></p>
<p><small>Copyright © 2011 Awesomest Blog. All rights reserved.</small></p>
```

## Discussion

HTML5 redefined the previously presentational `small` as semantically appropriate for content typically considered “small print,” such as legalese, disclaimers, terms, conditions and copyrights. And though `small` is supposed to indicate semantics only, browsers do display content a bit smaller by default (see [Figure 1-5](#)).

## See Also

The W3C Working Draft discussion of text-level semantics in HTML5 includes the `<small>` element at <http://www.w3.org/TR/html5/text-level-semantics.html#the-small-element>.

# Defining Acronyms & Abbreviations

## Problem

You want to provide expanded definitions for acronyms and abbreviations.

## Solution

Contain the abbreviation or acronym with `abbr`, and include the definition as the `title` value:

```
<abbr title="Accessible Rich Internet Applications">ARIA</abbr>
```



Figure 1-6. Default rendering of `<abbr>` tooltip in Firefox 5.0.

## Discussion

In previous versions of HTML we had both the `abbr` and the `acronym` elements. Not surprisingly in the always-ready-for-a-debate web world, these two elements caused much controversy.

Part of the issue is that prior to version 7, IE didn't display the `title` value of `abbr` as a tooltip (see [Figure 1-6](#)). To get around this usability limitation, authors simply started using `acronym`, regardless of whether the content was actually an acronym.

Another part of the issue was the argument about what was an acronym vs. what constituted an abbreviation.

Today, the debate ends (at least for practical purposes), as `acronym` has been dropped completely from the HTML5 specification. The reasoning is that all acronyms are shortened forms of words or phrases, which is the very definition of an abbreviation.

## See Also

WHATWG's Living Standard's text-level semantics includes `<abbr>` at: <http://www.whatwg.org/specs/web-apps/current-work/multipage/text-level-semantics.html#the-abbr-element>.

# Adding Links to Block-Level Content

## Problem

You want to wrap your site logo and main heading with a single hyperlink.

## Solution

Contain both the logo image and the heading with the `a` element:

```
<a href="http://html5funprofit.com">
    <h1>HTML5, for Fun & Profit</h1>
    
</a>>
```

## Discussion

Previous versions of HTML restricted `a` to inline content. So, if you had different elements that all needed to be linked to the same resource, you had to individually specify the `a` for each:

```
<h1><a href="http://html5funprofit.com">HTML5, for Fun & Profit</a></h1>
<a href="http://html5funprofit.com"></a>
```

Now, with HTML5, `a` elements can contain block-level elements. You can also still use `a` as in the past, for containing inline content. The only thing you can't nest inside an `a` is another `a`.



This alone is a great reason for using the HTML5 DOCTYPE.

## See Also

HTML5 Doctor's article "'Block-level' links in HTML5" at <http://html5doctor.com/block-level-links-in-html-5/>.

# Marking Up Figures and Captions

## Problem

You want to include an illustration with a caption on your web page.

## Solution

Contain the illustration image with the `figure` element, and include the caption text within `figcaption`:

```
<figure>
  
  <figcaption>The increasing amount of awesome that this blog demonstrates.</figcaption>
</figure>
```

## Discussion

`figure` and `figcaption` are both two new elements introduced in HTML5. Though the above example references an illustration (`img`), `figure` is not restricted to that type of content. It can be used to specify code examples, photos, charts, audio and data tables, to name just a few.

Why so many different types of content? Because the spec defines **figure** (<http://www.w3.org/TR/html-markup/figure.html>) rather broadly:

“... a unit of content, optionally with a caption, that is self-contained, that is typically referenced as a single unit from the main flow of the document, and that can be moved away from the main flow of the document without affecting the document’s meaning.”

If you’ve been paying attention, it might’ve occurred to you that this definition sounds quite similar to that for **aside** (<http://www.w3.org/TR/html-markup/aside.html>). To know which element is most appropriate for your content, consider whether the content is essential for understanding the surrounding content. If it is not essential, only related, then use **aside**. Otherwise, **figure** is appropriate.

And keep in mind two things:

- **figcaption** is optional and can reside anywhere within **figure**, whether before or after the **figure** content.
- Just because this recipe’s example uses an image, doesn’t mean all images need to be contained by **figure**.

## See Also

HTML5 Doctor's "Simplequiz #4" on figures, captions and alt text at <http://html5doctor.com/html5-simplequiz-4-figures-captions-and-alt-text/>.

# Marking Up Dates and Times

## Problem

You want to encode date-time content for machines, but still retain human readability.

## Solution

Wrap the human-friendly date-time information in the **time** element, and specify the machine-readable information via the **datetime** attribute:

```
<p>Published: <time datetime="2011-01-15">January 15, 2011</time></p>
```

Depending on the date and time you are trying to specify, the following approaches are also valid:

*Time only*

```
<p>The class starts at <time datetime="08:00">8:00 am</time>.</p>
```

*Date and time (requires time zone specification)*

```
<p>Registration opens on <time datetime="2011-01-15T08:00-07:00">January 15, 2011 at 8:00 am, Mount
```

*Visible machine-readable format (no date-time required)*

```
<p>Published: <time>2011-01-15</time></p>
```

## Discussion

Before we discuss this new element, let's first address *machine-readability*. This is simply the notion of enriching your web content with additional, semantic information that machines (search engines, users agents, etc.) can parse to glean more meaning from your content.

Next, let's talk date-time information on the web. For machine-readability, date-time has to be specified in the international standard format, *ISO 8601*. For dates, the format is *YYYY-MM-DD*. For times of day, the format is *hh:mm:ss*. And when combining dates with times, you join the numeric representations with a T: *YYYY-MM-DDThh:mm:ss*.

Okay, back to the new `time` element: as you can see from the examples, you can specify dates, times and date-times. What the human user experiences is the content contained by time. What machines read is the `datetime` ISO 8601 value.



To date, we're not aware of any machines that are currently parsing the `datetime` information from `time`. But we can imagine this soon be on the horizon, particularly for search engines that want to accurately display time-sensitive results for news queries.

One limitation of `time` that is worth mentioning is that it can't be used for imprecise dates such as August 2011. It does require, minimally, the day, month and year for dates.

## What About Microformats?

By this point, perhaps, you are wondering about *microformats* (<http://microformats.org>), which are HTML-based design patterns for expressing machine-readable semantics. The hCalendar (<http://microformats.org/hCalendar>) microformat, for example, is used for indicating date-time information.



Want to learn more about microformats? Check out Emily Lewis' *Microformats Made Simple* (<http://microformatsmadesimple.com>) for lots of practical examples and easy-to-understand explanations.

Neither HTML5 generally, nor the `time` element specifically, negate the use of microformats. You can still use them. In fact, the `time` element *would* make a great semantic hook for adding hCalendar. Yet current microformats parsers don't recognize the `time` element, so the two can't be used together.

This is unfortunate for a POSH and microformats devotee, but it is the reality of this industry.

As new technologies evolve, older technologies respond, and we designers and developers have to weigh the pros, the cons and the future.

## Publication Dates

Another new date-related feature in HTML5 is the `pubdate` attribute for `time`. Adding this attribute indicates that the `time` is the actual publication date-time for a web page or an article (such as a blog post) on a page:

```
<p>Published: <time datetime="2011-01-09" pubdate>January 9, 2011</time></p>
```

This helps differentiate publication dates from other instances of `time` on a page or within an article.

## See Also

Mark Pilgrim's "Dive Into HTML5" discussion on dates and times at: <http://diveintohtml5.org/semantics.html#time-element>.

# Setting the Stage for Native Expanding and Collapsing

## Problem

You want to provide content that can expand and collapse with user focus (once browsers support it).

## Solution

Contain the full content with the `details` element and indicate the content area that is “focusable” with `summary`:

```
<details>
  <summary>Upcoming Topics</summary>
  <p>For the new year, we have a great line up of articles!</p>
  <ul>
    <li>Understanding the Outline Algorithm</li>
    <li>When to Use <code>hgroup</code></li>
    <li>Machine Semantics with Microdata</li>
  </ul>
</details>
```



Figure 1-7. Default display of `<summary>` in Chrome 13 with collapsed `<details>` content.

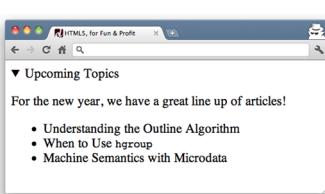


Figure 1-8. Default display of `<summary>` in Chrome 13 with `<details open>`.

## Discussion

This Recipe sets up a solid semantic structure for a very common behavior that we currently have to use JavaScript to achieve.

The `summary` element indicates which content is the “control” that expands or collapses the full `details` content upon user focus (see Figure 1-7). And, if you wanted to ensure that `details` was expanded by default (see Figure 1-8), you can add the `open` attribute:

```
<details open>
```

Only Chrome currently supports this behavior. For the other browsers you still have to use JavaScript to create expanding/collapsing content, because none of today’s browsers support the functionality of `details` and `summary`.

## See Also

Remy Sharp has put together a nice little script that forces browsers to apply the expanding and collapsing behavior to `details` at <https://gist.github.com/370590>.



Figure 1-9. Default rendering of `<ol start="3">` in Firefox 5.0.

## Controlling the Numbering of Your Lists

### Problem

You want an ordered list to have numbering different than the default of starting with 1.

### Solution

Specify one of the semantic control attributes on the `ol` or `li`. For instance, to start a numbered list at three (see Figure 1-9), include the `start` attribute in your `ol` and specify 3 as the value:

```
<ol start="3">
  <li>Apples</li>
  <li>Oranges</li>
  <li>Bananas</li>
</ol>
```

### Discussion

`start` has been around for a while, but was deprecated as presentational. HTML5 now recognizes the semantic value of controlled numbering and welcomes it back. And this “reordering” via `start` works the same across all browsers. Yes, IE6 included.

Another attribute for controlling the numbering of your ordered list is the `reversed` attribute, which reverses the order of a list, such as a countdown from 10:

```
<ol reversed>
  <li>Apples</li>
  <li>Oranges</li>
  <li>Bananas</li>
</ol>
```

Unfortunately, none of the current browsers support this attribute *yet*.



Figure 1-10. Ordered list with specified `<li>` values.

You can also specify the exact number value for each `li` which could come in handy if you are ranking something and there is a “tie” (see Figure 1-10):

```
<p>The results are in for your favorite fruit, and we have a tie for first place!</p>
<ol>
    <li value="1">Bananas</li>
    <li value="1">Oranges</li>
    <li value="2">Apples</li>
</ol>
```

The `value` attribute for `li` is also supported by all current browsers.

## See Also

The W3C's Working Draft about grouping content includes the `ol` element at <http://www.w3.org/TR/html5/grouping-content.html#the-ol-element>.

# Hide Content to Show Later

## Problem

You have content that you want to hide until after a user logs in.

## Solution

Add the `hidden` attribute to the element containing the content to be temporarily hidden:

```
<p hidden>As a special deal for members, use discount code AWESOMESAUCE and save 10% off all purchases!
```

## Discussion

The `hidden` attribute is one of the more controversial additions to HTML5.

As the spec defines it, `hidden` should be applied to content that is *not yet or no longer relevant* to the current user view and, as such, should not be rendered by browsers.

The Document Object Model (DOM) and machines like search engines, though, can still access the content.

This means that if the content does become relevant to the user view, it can be targeted via JavaScript, for example, and displayed by removing the attribute.

Where the concerns lie is in the misunderstanding and abuse of this attribute. It is *not* to be used for the temporary show/hide that you may encounter with tabbed content and the like.

Further, we already have CSS solutions that address the display of content such as `display: none` and `visibility: hidden`.

There is semantic value of `hidden`, especially compared to the CSS alternative. If this attribute remains in the specification, perhaps over time, the concerns may prove unnecessary.



Just remember: do *not* use `hidden` for presentational purposes and don't rely on browsers to actually *hide* the content. Use it only for semantic purposes and use CSS to control presentation.

## See Also

Peter Beverloo's article "Thoughts on the HTML5 hidden attribute" at <http://peter.sh/2010/06/thoughts-on-the-html5-hidden-attribute/>.

# Making Portions of a Page Editable

## Problem

You want to allow users to directly edit content in the browser.

## Solution

Add the `contenteditable` attribute to the element containing the content to be edited:

```
<article contenteditable>
  <h2>Stop <code>section</code> Abuse!</h2>
  <p>As the most generic of the HTML5 structural elements, <code>section</code> is often incorrectly used</p>
</article>
```

## Discussion

This attribute is well supported by today's browsers, including IE6. In fact, `contenteditable` first appeared in IE 5.5 and has since been incorporated by other browsers. It



Figure 1-11. Once focus is set on element assigned `contenteditable`, Firefox 5.0 displays a gray dotted line appears around it, indicating the area that can be edited.

was originally intended to support in-browser editing such as a What You See Is What You Get (WYSIWYG) editor.

However, on its own, it only allows users to edit content. It does not have any functionality to save those edits, nor does it generate editing controls commonly seen in WYSIWYG editors. For that type of editing, you need to incorporate JavaScript and utilize the local storage Application Programming Interface (API) (see [Chapter 8](#)).

A good example of when to use `contenteditable` is for demonstrating the use of how text should look like when styled with CSS rules or set with a certain typeface, while allowing users to edit their own text (see [Figure 1-11](#)).

## See Also

W3C's Working Draft discussion on user interaction includes the `contentEditable` attribute at: <http://www.w3.org/TR/html5/editing.html#contenteditable>.

# Set the Stage for Native Drag and Drop

## Problem

You want to allow users to drag and drop content on your web page.

## Solution

Add the `draggable` attribute to the element that should be draggable:

```
<h2 draggable>Block-Level Links</h2>
```

## Discussion

`draggable`, like `contenteditable`, has good browser support and was originally introduced for IE. By default, certain elements are already draggable: `a` and `img`. However, the simple addition of `draggable` to your elements does not create the drag-n-drop scenario on its own. `draggable` simply allows you to specify the elements that *can* be dragged.

To achieve the desired drag and drop functionality, you need JavaScript to:

1. Tell the browser where the draggable element can be dropped (the drop “zone”)
2. Tell the browser what to do with the element once it has been dropped

## See Also

- WHATWG's Living Standard addresses the draggable attribute at <http://www.whatwg.org/specs/web-apps/current-work/multipage/dnd.html#the-draggable-attribute>.
- HTML5 Doctor features a simple, yet straightforward tutorial on implementing basic drag and drop at <http://html5doctor.com/native-drag-and-drop>.
- “Drag and Drop” on page 209 in Chapter 10 of this book.



# Progressive Markup & Techniques

*Christina Huggins Ramey*

## Introduction

As a web developer, you may be eager to implement HTML5's new features within your website. However, HTML5 is still a budding technology, and browser-support for many of its features is spotty at best.

Your excitement at the prospect of a cutting-edge HTML5 site may be tempered by the following questions:

- How can I accommodate browsers that have yet to support many of HTML5's elements?
- What are the current best practices for coding a standards-compliant, cross-browser compatible HTML5 website?

In this chapter you will learn how to test for supported HTML5 features within a browser, and the latest techniques for accommodating for those features that aren't. You will learn how to get started quickly with an HTML5 boilerplate template that includes all of the latest tricks, techniques, and best practices for implementing HTML5 technologies. You'll find out how to validate your HTML5 documents, and even how to code your XHTML/HTML4 documents for future HTML5 upgradability.

After learning the techniques of this chapter, you will have the confidence to integrate modern HTML5 web technologies within your web pages, even as browser technology is still catching up with them.

## Adding More Semantic Meaning

### Problem

You want to markup content correctly.

## Solution

Apply markup in a semantic manner.

*Semantic markup* is markup that describes the content it contains, rather than what the content should look like.

This means coding paragraphs with the `p` element, titles with heading elements, and so on.

## Discussion

Sometimes referred to as Plain Old Semantic Markup (POSH), semantic markup eschews presentational elements like `font` or `table` for layout (see <http://microformats.org/wiki/posh>).

POSH focuses on content. If you have a paragraph, use `p`. A heading? `h1`. The point is to use the element that best describes the content.

Become familiar with the changes in HTML5 so that your code remains both semantic and valid: HTML5 redefined several elements and completely dropped others, like `frame`, `frameset` and `noframes`.

Also gone are presentational elements and attributes, as shown in [Table 2-1](#).

*Table 2-1. Sampling of obsolete presentational features in HTML5.*

Elements	Attributes
<code>basefont</code>	<code>align</code>
<code>big</code>	<code>background</code>
<code>center</code>	<code>bgcolor</code>
<code>font</code>	<code>border</code>
<code>plaintext</code>	<code>cellpadding</code>
<code>s</code>	<code>cellspacing</code>
<code>strike</code>	<code>height</code>
<code>tt</code>	<code>nowrap</code>
<code>u</code>	<code>v-align</code>
	<code>width</code>

## See Also

For tips and tricks on how to style semantic markup, read *CSS Cookbook, Third Edition* by Christopher Schmitt; for the full list of obsolete elements and attributes, visit <http://www.w3.org/TR/html5/obsolete.html>.

# Picking a Markup Style

## Problem

You want to know what kind of syntax coding style to use.

## Solution

One of the core changes HTML5 brings is a more relaxed syntax. Thanks to a simplified DOCTYPE, all coding styles are valid. HTML and XHTML are both welcome at the party:

- Uppercase tag names
- Optional quotes for attributes
- Optional values for attributes
- Optional closed empty elements

So, if you want to write loose and free, without concern for casing, quotes, or attribute values, you can go forth with confidence; your syntax will validate.

That being said, it is worth noting that valid syntax doesn't necessarily equal good syntax, and that many developers still tout certain "best practices" which lend to clarity in your code. These best practices include the following suggestions:

- Code your tag names in lowercase. Uppercase is more difficult to read than lowercase, and distinguishing your code from your content in this manner is unnecessary: Any decent text editor will color-code your HTML document so that you can visually pick out your tags with ease.
- Enclose all attribute values in quotes. There might be instances in which you need to use quotes. E.g., if there is more than one value, so doing this universally helps to eliminate coding errors and lends to a consistent look.
- Close all elements with content. Knowing where a `div` ends just makes for clearer code, and doing this consistently enhances clarity makes your code easier to maintain.

## Discussion

Whatever coding style you use, consistency is key: adhering to a strict syntax can help you more quickly identify errors in your markup.

A major benefit is that a strict syntax is easier to standardize for development teams. A standard convention can save hours in development time, particularly for large projects with distributed team members.

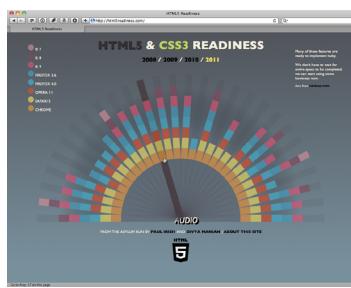


Figure 2-1. A visual representation of native HTML5 audio support in modern browsers.

Ultimately, though, there is no right or wrong style in HTML5. Simply follow a style that helps you develop code consistently and troubleshoot efficiently.

## See Also

For more style recommendations, see: <http://www.fredzlinkz.com/webcitymaster/html5-syntax-style-recommendations>.

# Understanding Browser Support for HTML5

## Problem

You want to find out if a browser or specific browser version supports a feature of HTML5.

## Solution

As of this writing, the HTML5 specification is still evolving. Even though browsers are implementing portions of the specification before it's complete, support in modern browsers is neither 100% complete nor should it be.

As discussed in the preface and demonstrated by the chapters in this book, there is a sizable portion of the HTML5 specification that is supported and can be utilized immediately.

For a breakdown of HTML5 support across browsers, see <http://caniuse.com/#cats=HTML5>. A visual representation of HTML5 as well as CSS3 can be seen at <http://html5readiness.com> as shown in Figure 2-1.

## Discussion

Generally speaking, all of today's latest browsers support HTML5 to some degree or another.

Using HTML5 isn't an absolute proposition. You don't have to use embedded content or web sockets to use the new structural elements and vice versa. You don't even have to use the new structural elements to have a valid HTML5 document; you just need the Document Type Definition (see “[Specifying the DOCTYPE](#)” on page 1).

Pick the features that work for you, and leave the rest. Or, rather, *experiment* with the rest to see if you may find a practical implementation for yourself or your projects.

## See Also

For a visual representation of browser support for HTML5 and CSS3, see <http://html5readiness.com>.

# Making Internet Explorer Recognize HTML5 Elements

## Problem

Internet Explorer doesn't apply CSS to elements it doesn't recognize. And, unfortunately, Internet Explorer (prior to IE9) doesn't yet recognize most HTML5 elements. So, implementing HTML5 is difficult, as Internet Explorer won't render any CSS that you apply to these new elements.

## Solution

A clever solution to this problem, attributed to Sjoerd Visscher (see <http://intertwingly.net/blog/2008/01/22/Best-Standards-Support#c1201006277>), and known as the shim technique, involves creating a DOM element of the same name as the HTML5 element that you want to use. Once you create this element, Internet Explorer will apply CSS to it.

For example, let's say you create the following simple body header that includes a navigation element:

```
<header>
  <h1>Riddles of the Sphinx</h1>
  <nav>
    <ul>
      <li><a href="index.html">Home</a></li>
      <li><a href="/about/">About</a></li>
      <li><a href="/blog/">Blog</a></li>
      <li><a href="/contact/">Contact Me</a></li>
    </ul>
```

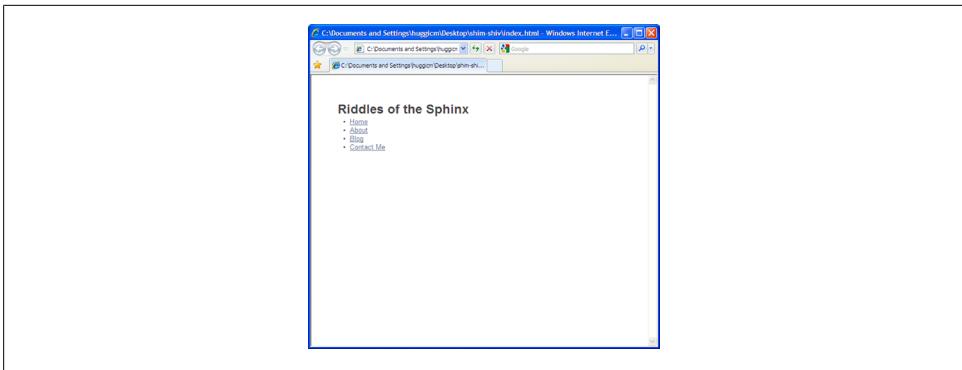


Figure 2-2. Basic rendering of the list.

```
</nav>  
</header>
```

Then, style these elements:

```
header {  
    width: 600px;  
    height: 25px;  
    background-color: #ccffff;  
    border: 2px solid #66cc99;  
    padding: 10px;  
}  
  
nav {  
    width: 100%;  
    float: left;  
    list-style: none;  
}  
  
nav li {  
    float: left;  
    padding-right: 7px;  
}
```

When we view this page in Internet Explorer 8 or below (as shown in Figure 2-2), the CSS is not applied.

For Internet Explorer to recognize these elements, just add the following script to the head of the HTML document (make sure you add it to the head of the document, as the elements need to be declared before the page renders):

```
<script>  
    document.createElement("header");  
    document.createElement("nav");  
    document.createElement("footer");  
</script>
```

Then declare the three HTML5 elements that we've used on the page—`header`, `nav`, and `footer`—as DOM elements.

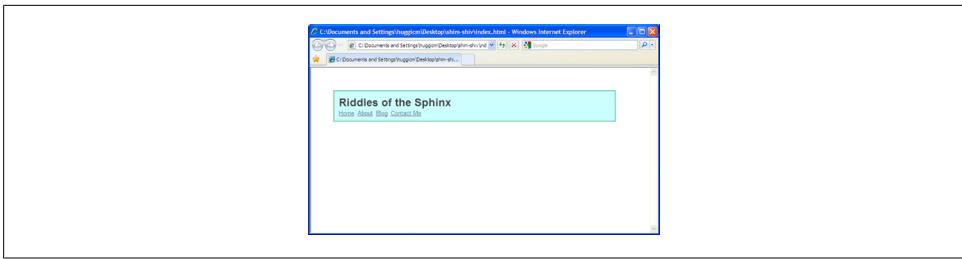


Figure 2-3. Internet Explorer recognizes the elements.

Now, when we view this page in Internet Explorer (as shown in Figure 2-3), the browser sees these elements and applies its CSS.

## Discussion

While this technique is effective, it can become cumbersome to create DOM elements for all of the HTML5 elements on a page, especially if you are making heavy use of many of them.

Web developer Remy Sharp has created a script that enables *all* of the HTML5 elements. Integrating this script into your page can be much more convenient than hand coding a script every time you want to sprinkle some HTML5 into your page.

You can download the script at <http://remysharp.com/2009/01/07/html5-enabling-script/>, and integrate into the head of your HTML.

Or, you can hotlink the script from the Google code repository:

```
<!--[if lt IE 9]>
  <script src="http://html5shim.googlecode.com/svn/trunk/html5.js"></script>
<![endif]-->
```

If you wrap this code within this conditional, it will only call the script if the browser is Internet Explorer 8 or lower (IE9 has broad-range support for HTML5 elements and technologies).

## See Also

See Also: John Resig's blog post detailing the HTML Shim technique (but Resig calls "shiv" in his blog post): <http://ejohn.org/blog/html5-shiv/>.

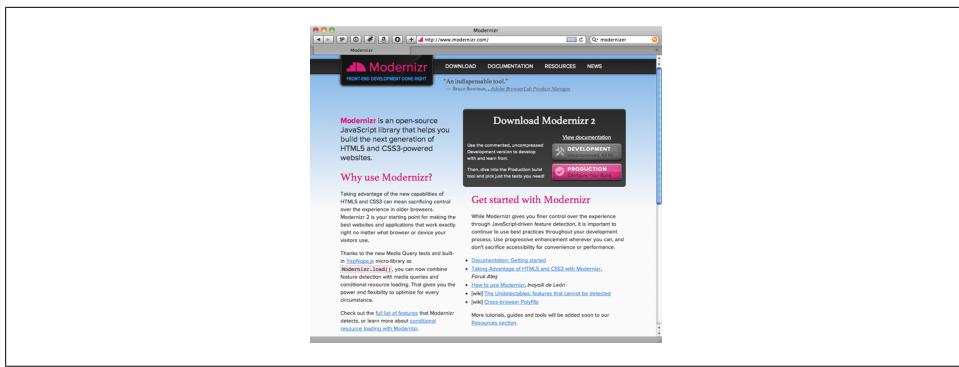


Figure 2-4. The Modernizr site.

## Detecting HTML5 Features with JavaScript

### Problem

You want to implement HTML5 features when they're supported by the browser, but degrade to another solution when they're not.

### Solution

HTML5 comes with great cutting-edge technologies that, as a designer, you may be eager to take advantage of.

Unfortunately, HTML5 currently comes with limited browser support. You may like to implement some of these new technologies, but you also want to accommodate browsers that don't yet support them.

Modernizr (see <http://modernizr.com>) is a JavaScript library that makes it very easy to do just that: it detects the availability of various HTML5 and CSS3 features within a user's browser, and allows you to create fallbacks when a desired feature isn't currently supported (see Figure 2-4).

### Using Modernizr

To see how Modernizr works, let's run through an example using the JavaScript library where we create an audio player using HTML5's `audio` tag. If the user is viewing the page with a browser that doesn't support the `audio` element, we want to display an error message alerting the user of the problem.



If we want to be really make this page cross-browser compatible, we would probably use a Flash audio player as a fallback. However, we want to keep this example fairly simple for the purposes of this example.

Here is our basic HTML code for our player:

```

<div id="caption">
    <div id="audio">
        <audio>
            <source src="turnthepage.ogg">
            <source src="turnthepage.mp3" />
        </audio>
        <p><input type=button onclick="playPause()" value=" " tabindex="0" /> Turn the Page</p>
    </div>
</div><!-- end caption-->
```

We've included an image of the album cover art, and our audio element along with customized controls.

First, download the Modernizr JavaScript library from <http://modernizr.com>. Include reference to this file within the `<head>` of your HTML document:

```
<script src="js/modernizr-1.6.min.js"></script>
```



This script must be included in the `<head>` of your document with a normal `<script>` tag; it cannot be loaded dynamically with script loader techniques.

Once this script runs, it detects whether or not the browser supports the audio element, and then it:

1. Assigns a value (true or false) to the JavaScript property `Modernizr.audio`, and
2. Adds a class to the HTML tag. If the browser supports the audio element, it will add a class called “audio.” If the browser doesn't support the audio element, it will add a class called “no-audio.”

Now you can write a script specifying what to do if the `Modernizr.audio` property is true or false, and code your CSS specifying styles for elements when the audio element is supported and when it isn't.

So, let's write a small script (we can put this in the head of our document) that only runs when the audio element is supported:

```
<script>
if (Modernizr.audio) {
    function playPause() {
        var myAudio = document.getElementsByTagName('audio')[0];
        if(myAudio.paused)
            myAudio.play();
        else
            myAudio.pause();
    }
}
</script>
```

This script adds functionality to the custom controls we added to the page. This script will only activate if the `Modernizr.audio` value is true (and thus won't waste browser resources in the instance that it doesn't support the audio element).

Next, it would be nice if we could get rid of the customized controls altogether when the browser doesn't support the audio element. This is easy to do with Modernizr, as we can take advantage of the class it added to the HTML tag:

```
.no-audio #audio {  
    display: none;  
}  
  
.audio #audio input[type="button"] {  
    width: 45px;  
    height: 29px;  
    background: url(button.png);  
    border: 0px solid #000;  
    float: left;  
    margin-right: 10px;  
}
```

When the audio element isn't supported, Modernizr adds a “no-audio” class to the header element. So, we can select for this class in our CSS, and set the display value for “none” for any element we want to disappear.

Here, it would be the `div` we labeled “audio,” which encloses the controls.

When the audio element *is* supported, however, it adds the “audio” class to the header element, instead.

So, we can select for this `class`, too, and style our control button as we please.

The next step is to set up a an error message when the audio element isn't supported.

First, we need to add the HTML for this error box to our HTML and then place a notice underneath the “audio” `div`:

```
<div id="error">  
    <p>&ldquo;Turn the Page&rdquo; / <em>Veil & Subdue</em> / Paul Ramey</p>  
    <div id="error-box">  
        <p>Too bad! This browser does not support the audio features on this page. Might I suggest installing  
        </div>  
    </div>
```

Using the same basic technique as above, we can hide this `div` when the element is supported, and style it appropriately when audio is not supported:

```
.audio #error {  
    display: none;  
}  
  
.no-audio #error-box {  
    background-color: #ffffcc;  
    padding: 1px 10px;  
    color: #0000;
```



Figure 2-5. The audio controls appear in the browser that supports the `audio` element.

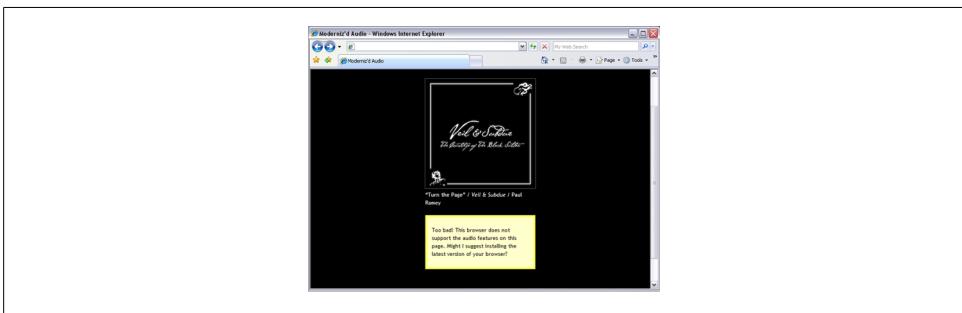


Figure 2-6. How the page looks when the `audio` element is not supported.

```
border: 5px solid #fffff66;  
  
}  
.no-audio #error-box a {  
    color: #333;  
}
```

Figure 2-5 shows the `audio` element supported by the browser, while Figure 2-6 shows the result from a browser that does not support the `audio` element.

Currently Modernizr checks for over twenty HTML5 and CSS3 features and also includes the shim technique covered in the previous section.

Each checked feature comes with its own specific CSS classes and JavaScript property. Check out Modernizr's documentation at <http://modernizr.com/docs/>, which includes sample code for each feature that it supports.



For more information and Recipes on using HTML5 audio, see Chapter 5.

## Discussion

Modernizr isn't the only tool available to assess and work around this issue: Traditionally, “UA-sniffing” or “browser-sniffing” was used to determine which browser a user was running. Then, the designer could implement browser-specific code to customize the page.

This method, however, is unreliable in a number of ways. First of all, a browser can fake a UA string, which is the value that the browser-sniffing technique looks at to determine the browser.

Additionally, users can switch off certain features of their browsers, so that even if you can determine the correct browser, you still can't be sure which features are supported.

Also, if the user is running a new browser, a newer version of a browser, or an alternative browser that you may not have bothered to check for, your code may fail to recognize it altogether. Not to mention that it falls on *your* shoulders to be on top of what browsers support which features.

Modernizr avoids these pitfalls, as it detects, specifically, which *features* are supported, rather than merely trying to detect what browser the user is viewing the page through. This is a far more reliable method if you want fine-tuned control over the user's experience of your web site.



Modernizr now supports a “production” version (see <http://www.modernizr.com/download/>). This version generates a custom build of Modernizr with only the HTML5 tests needed for your sites or web applications.

## See Also

The documentation on the official Modernizr website at <http://www.modernizr.com/docs/>.

## Using HTML5 Boilerplate

### Problem

You want to get up and running with HTML5 with a robust working template.

### Solution

Use Paul Irish’s HTML5 Boilerplate (as shown in [Figure 2-7](#)) as a jumping-off point for your website. Not only does it include an HTML5 template complete with an organized



Figure 2-7. HTML5 Boilerplate site.

folder structure and CSS file, it also incorporates current coding best practices, browser bug fixes, and popular JavaScript libraries.

It incorporates three years of research into current cutting-edge coding techniques, so you can just get on with building your web site. In fact, HTML5 Boilerplate includes so much, that it would be time prohibitive to mention it all. So, here are some of its highlights:

- An index.html file which includes:
  - Valid HTML5 markup
  - References to JavaScript libraries Modernizr and jQuery (which are included with the template)
  - Conditional statements that add classes to body tags based on what version of Internet Explorer the page is being viewed on (so you can easily create IE6 or IE7-specific styles)
  - A basic structural skeleton within the <body> tag
  - IE6 .png fix script
  - Google analytics script
- CSS file that includes:
  - A global reset
  - Font normalization (so your fonts are sized the same across all browsers)
  - Some basic styles for lists, tables, and so on
  - A few non-semantic classes (for image replacement and element hiding)
  - Print styles
  - Space for mobile browser and orientation styles (for e.g., an iPad displayed horizontally vs. vertically)
- A favicon and Apple touch icon (which you'll probably want to customize)
- Webserver config files

While a dizzying array of cutting-edge web technology, it's fairly simple to get started with using the boilerplate.

## Using the HTML5 Boilerplate

First, download the latest version of the HTML5 Boilerplate from <https://github.com/paulirish/html5-boilerplate>.

Unzip the files and place the files at the root of your web project.

Paul Irish suggests that you start off by deleting a couple of things:

1. The demo files (located in a folder called “Demo”)
2. Profiler code (located near bottom of the index.html file; it begins with the comment “yui profiler and profileviewer - remove for production”)

Use the `index.html` file as a template for all of your HTML documents. Flesh out the basic elements and div containers included in the file. Or, start from scratch and create your own: while his skeleton is a great start, feel free to take it as a starting point.

You'll also want to customize the information in the head of the document (the title, author, and so on).

As a last tweak to your HTML document, add your site id to the Google analytics code at the bottom of the file. (If you don't use Google analytics, you'll want to delete this section.)

Then, you'll want to customize the style.css file. The boilerplate CSS file has a space for your primary CSS. It begins with the comment:

```
/* Primary Styles
Author:
*/
```

Once you've added the primary CSS, feel free to add orientation styles and mobile browser styles. You'll find these under the section beginning with the comment:

```
/*
 * Media queries for responsive design
 * These follow after primary styles so they will successfully override.
*/
```

Finally, customize the favicon and Apple touch icon. That should be as easy as replacing the current icons included in the boilerplate files.

## Discussion

While it's fairly simple to get a basic HTML5 site started with HTML5 Boilerplate, to really get the most out of the boilerplate, you'll want to study the online documentation to understand some of what is going on with the code.

For instance, if you don't understand the classes that the boilerplate includes in the HTML (such as the IE body classes or the image-replacement class), you won't be able to take advantage of these useful bits of CSS in your site. If you don't know how to implement IE6 .png fix that's included with the boilerplate, then the script turns out to be fairly useless.

Additionally, there may be some things you'll want to get rid of, if you don't use them. Delete the IE6 .png script, if you don't care about supporting IE6. Or, delete the .htaccess file, if you aren't on an Apache server. Knowing what is included in the boilerplate makes it easy to trim down the boilerplate to include only what you need.

That's not to say you need spend hours poring over the documentation to understand every bit of its inner workings. You might as well create your own boilerplate, if you go through all that trouble.

However, it will behoove you to get an overview of the pieces that make up the boilerplate; that way, if there is something you think may be useful for your site, you can study that bit in more detail.

## See Also

- The Official Guide to HTML5 Boilerplate at: <http://net.tutsplus.com/tutorials/html-css-techniques/the-official-guide-to-html5-boilerplate/>.
- The HTML5 Boilerplate Documentation at: <https://github.com/paulirish/html5-boilerplate/wiki>.

# Validating HTML5

## Problem

You want to identify and eliminate coding errors in your HTML.

## Solution

Validating your code is one of the key *best practices* in web development, and is a great first step in eliminating coding errors. While validation doesn't guarantee that your web page will look or behave like you expect, it does guarantee that any unexpected behavior is not due to a mismatched tag or unrecognized CSS selector.

Why validate? Fortunately (or unfortunately, depending on your position on web standards), most web browsers try and compensate for invalid coding. So, even a horrendous collection of tag soup consisting of mismatched tags and improper nesting will probably look okay in most browsers. However, different browsers handle errors differently.



Figure 2-8. The unified validator dubbed *Unicorn*.

So, if your code isn't valid, a browser can try to compensate for errors in unexpected ways. Additionally, mobile browsers are less forgiving of erroneous code (they simply don't have the resources to compensate for errors the way that desktop browsers can). So, an invalid page that renders fine on your desktop browser may break on your mobile phone. In light of modern web technologies, it is becoming increasingly important to validate your code and eliminate errors. In doing so, you go one step further in ensuring that your web page renders as expected across multiple browsing environments.

Fortunately, validating for HTML5 is not much different than validating XHTML/HTML4. Indeed, you may find that creating a valid HTML5 document is much easier, as HTML5 specifications, in general, are much more lenient than their predecessor. If you want to capitalize your HTML tags, go ahead. The HTML will still validate.

If you're too lazy to close out your `li` tags, you need not feel guilty for doing so. The validator won't chastise you—it will leave that job up to your colleagues.

So, let's get on to the business of validating our code. Currently, there are two popular online validators that you can use:

- W3C's "Unicorn" Unified validator, which performs a variety of checks, and can validate HTML5 and CSS3: <http://validator.w3.org/unicorn/> as shown in Figure 2-8.
- Validator.nu HTML5 Validator: <http://html5.validator.nu/>.

To check your code, you can enter the URL, upload your HTML file, or simply paste the contents of the file into the validator. Once you check the code, the validator will either verify that the code is valid HTML (and CSS, if you are checking that as well), or, it will present you with a list of errors, by line number as shown in Figure 2-9.

Note that you will usually need to run your page through the validator frequently: Many syntax errors (e.g., an improperly closed tag) can generate a cascade of further errors that are eliminated when the initial error is fixed. So, re-validate your document as you correct your errors.

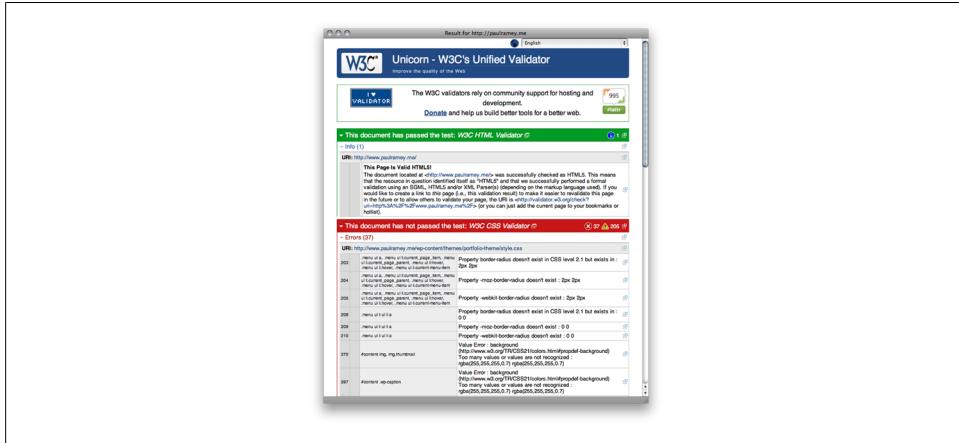


Figure 2-9. Validator results.

Currently, W3C’s Unicorn validator checks CSS 2.1, by default, but you can customize this check to include CSS3 as well.

## Discussion

Validation isn’t the end-all, be-all of good HTML coding.

There may be instances in which you purposefully include invalid code in your HTML document. Perhaps there is a necessary hack that doesn’t validate, or there is a piece of cutting-edge CSS that isn’t yet widely supported across browsers (and it thus not recognized by modern validators).

These can be perfectly valid reasons for having a web document that doesn’t validate. And while it may be controversial whether you should include said hack or CSS technique, intentionally including a piece of invalid code can still be a part of good web development practice.

Validation should be seen as one of many tools in your web development toolbox, and should not have the final say as to whether your page is coded correctly.

Validating your code is a great way to find unintentional errors in coding, and, all things being equal, a valid HTML5 document is generally better than an invalid one.

## See Also

The documentation for these two services at <http://code.w3.org/unicorn> and <http://about.validator.nu/>.

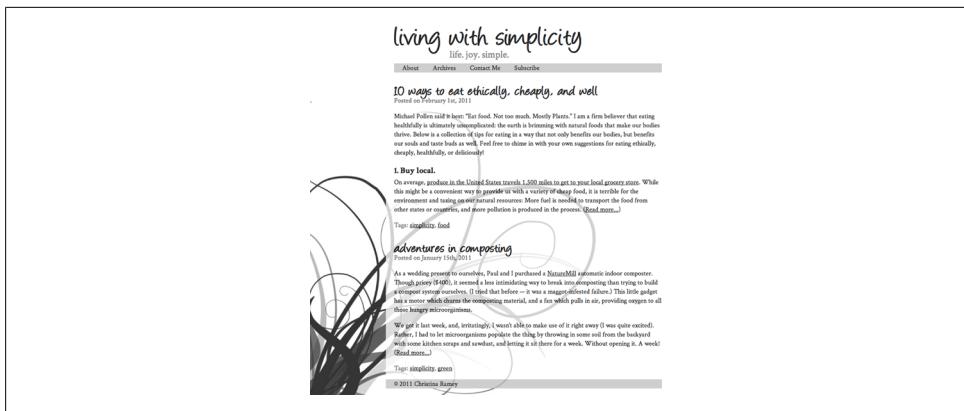


Figure 2-10. A sample web page.

## Mapping HTML5 Elements to id and class Names

### Problem

You aren't ready for HTML5 yet, but you want to code your site so that upgrading to HTML5 in the future will be painless.

### Solution

There may be legitimate reasons why you don't want to take the HTML5 plunge yet.

Perhaps you worry about browser support. Perhaps you like to keep things simple, and you don't want to implement the myriad of scripts and tweaks necessary to make an HTML5 site compatible with all modern browsers.

However, you still appreciate the semantic markup of HTML5. And you'd like to code your site so that, when all modern browsers catch up, your XHTML/HTML4 code will be as ready as possible for HTML5.

Fortunately, it's quite simple to mirror the semantic structure of an HTML5 site using divs labeled with HTML5-ish id and class names. Let's take a look at how this can be done.

We're going to create a simple blog front page as shown in [Figure 2-10](#).

By looking at this site, we can pick out a few key structural elements:

- A body header, which contains
  - the blog title, and
  - a navigation bar
- A section that contains

—two blog posts

- A footer

If we were coding this site in HTML5, we'd mark this up with various `<header>` and `<footer>` tags, a `<nav>` tag, and `<article>` tags. However, as we're going to mark this up with (X)HTML4 instead, we're going to mirror the structure and naming conventions of HTML5 as closely as possible using divs with id and class names.

First, let's work on the header:

```
<div id="header">
  <h1>living with simplicity</h1>
  <div id="tagline">
    life. joy. simple.
  </div>
  <div class="nav">
    <ul>
      <li><a href="/about/">About</a></li>
      <li><a href="/archives/">Archives</a></li>
      <li><a href="/contact/">Contact Me</a></li>
      <li><a href="/subscribe/">Subscribe</a></li>
    </ul>
  </div><!--end nav-->
</div><!--end header-->
```

Ultimately, this may differ little from how you would have initially coded this page. But note that we have mirrored the HTML5 element names with the “header” and “nav” divs. In HTML5, the `header` tag should include a heading tag (here we have our `h1` title tag), and can include the `nav` element as well (hence, the inclusion of the navigation bar within our header).

Next, let's markup our blog posts:

```
<div class="posts">
  <div class="article">
    <div class="header">
      <h1>10 ways to eat ethically, cheaply, and well</h1>
      <div class="meta">Posted on <span class="date">February 1st, 2011</span></div>
    </div><!--end header-->
    [Post Content]
    <div class="footer">
      <div class="meta">Tags: <a href="tags/simplicity" rel="tags">simplicity</a>, <a href="tags/food">food</a>
    </div><!--end footer-->
  </div><!--end article-->
  <div class="article">
    <div class="header">
      <h1>adventures in composting</h1>
      <div class="meta">Posted on <span class="date">January 15th, 2011</span></div>
    </div><!--end header-->
    [Post Content]
    <div class="footer">
      <div class="meta">Tags: <a href="tags/simplicity" rel="tags">simplicity</a>, <a href="tags/green/" rel="tags">green</a>
    </div><!--end footer-->
```

```
</div><!--end article-->
</div><!--end posts-->`
```

Note, first, that we've wrapped our posts in a div we labeled "posts." Now, you may be tempted to name it "section" (along with the corresponding HTML5 `section` tag). After all, a collection of blog posts does seem to account for its own generic section.

Recall, however, that the HTML5 `section` element is not meant to stand in for any old `div`: something is justifiably a "section" only if it has at least one `head` tag (i.e., only if it can represent a level in the outline of the HTML document.) This `div`, however, does not have a `head` tag, so we have given it an alternative semantic name.

Next, we've wrapped each post within a `div` that we've named "article." This corresponds to the `article` tag in HTML5. Each `article` `div`, in turn, has its own header and footer (which, again, would match up with the `header` and `footer` HTML5 tags).

Interestingly, we've also enclosed each post title in `h1` tags. Prior to HTML5, having more than one `h1` tag within an XHTML/HTML document was generally frowned upon. In order for your page to be outlined properly within the DOM, your `head` tags should follow a natural progression: `h3` tags followed `h2`, `h2` followed the `<h1>` tag, which enclosed the title of the page. With the advent of HTML5, this was no longer necessary: As the browser understood the `article` element, semantically, it could be ranked (and outlined) differently than, say, the `header` element.

You no longer needed to rely on the `head` tags to do all of the ranking and outlining of the information within your document—that task was replaced by these new semantically-rich elements.

So, each of your elements such as `header` or `article` can begin with their own `h1` tag. While it may seem strange to mirror this new coding convention in an XHTML/HTML4 document, it will nonetheless make it easier to transition your page to HTML5 later on.

Finally, we close our page with a `div` labeled "footer," which maps onto the HTML5 `footer` tag:

```
<div id="footer"> <p>&copy; 2011 Christina Ramey</p> </div>
```

Now, when you are ready to switch to HTML5, it will be easy enough to change all of these `divs` to their corresponding HTML5 tags, thus saving you the headache of having to do any major restructuring to your page.

## Discussion

There is no mystery to this technique of mapping of HTML5 tags to XHTML/HTML4 `divs`. Indeed, you many not need to alter your current coding technique much, if at all. However, once you decide on proper `id` and `class` names that mirror HTML5 tags, it is best to stick with that naming convention (particularly if you are coding a lot of pages).

That way, when it does come time to translate these pages to HTML5, you don't need to recall that you named your `header` "header" in one document, but "main-header"

in another. It will also make it easier to do a quick find-and-replace with your text editor across multiple documents.

If you need help coming up with an appropriate naming convention, there are some designers who have already gone through the trouble. Check out

## See Also

Oli Studholme's HTML5 id/class name cheat sheet at <http://oli.jp/2008/html5-class-cheatsheet/>.



# CHAPTER 3

# Forms

*Kimberly Blessing*

## Introduction

Forms are the workhorse of any web application. Whether you are updating your Facebook status, paying a bill online, or remotely programming your DVR, forms are making the magic happen.

Currently, making that magic both robust and seamless requires some interesting and tricky uses of HTML and JavaScript.

HTML5 makes much of this work far simpler – and even where browsers aren't yet supporting these new HTML5 form features, it's easy to add support with JavaScript on these building blocks.

HTML5 gives us new elements and input attribute values for the input element to yield new form fields, as well as new attributes that allow us to remove many lines of JavaScript.

However, since not all browsers yet support these new features, some JavaScript is still needed to ensure cross-browser compatibility.

## Displaying a Search Input Field

### Problem

You want to present a user with a search form field.

### Solution

Use the input element with HTML5 type value of `search`.

```
<form>
  <p><label>Search <input type="search" name="query"></label></p>
```

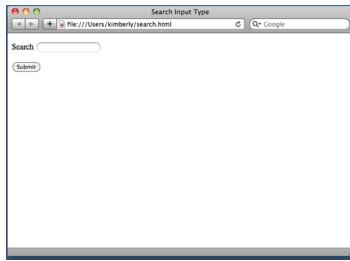


Figure 3-1. A blank search input field in Safari 5.

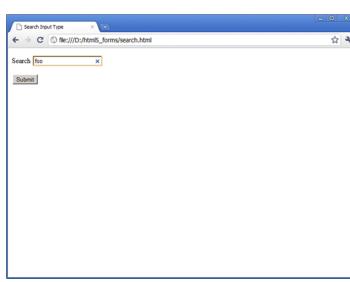


Figure 3-2. A search input field with content in Chrome 12.

```
<p><button type="submit">Submit</button></p>
</form>
```

## Discussion

The `search` input type displays a text input field that may visually differ from that of a regular text field, based on the stylistic conventions of the platform.

For example, Safari on MacOS displays the search field with rounded, instead of boxed, corners as shown in [Figure 3-1](#). Both Safari and Chrome display an icon within the field to delete the current value as shown in [Figure 3-2](#).

Some user agents will display a plain text input field for the `search` input type, so support cannot be determined by visual appearance alone.

## Testing Browser Support

To accurately test a browser's support (see [Table 3-1](#)) of the `search` input type, load Mike Taylor's support test page at <http://www.miketaylr.com/code/input-type-attr.html>. The page shows not only support for `search` attribute value, but other attribute values for `input` as well.

If a user agent does not support the `search` input type, it will revert to displaying a text input field.

*Table 3-1. Search input type support.*

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	4.0+	10+	4.0+	11.0+	✓	✓

What is the value in having a separate input type for search input fields, when only some user agents will render a visually different input field? There are a few answers to this question.

First, easily enabling operating system visual styles in the browser can make for a better user experience.

Second, designating a search input field as such may help assistive devices more correctly signal users as to the purpose of the field or form.

Finally, the search input type gives us a more semantic input type value to use in our forms, and gives us a better hook for our CSS, as compared to using a class or id.

```
input[type="search"] {  
    border-radius: 10px;  
}
```

The above CSS applies rounded corners to the search input field for all user agents that support the `border-radius` property.

## See Also

For more information on search inputs in WebKit browsers that includes Chrome and Safari, see <http://css-tricks.com/webkit-html5-search-inputs/>.

# Contact Information Input Fields

## Problem

You want to present a user with a form to provide contact information, such as an e-mail address, a URL, and a telephone number.

## Solution

Use the `input` element with HTML5 type values of `email`, `url`, and `tel`:

```
<form>  
    <fieldset>  
        <legend>Contact Information</legend>  
        <p><label>E-mail address <input type="email" name="email"></label></p>
```

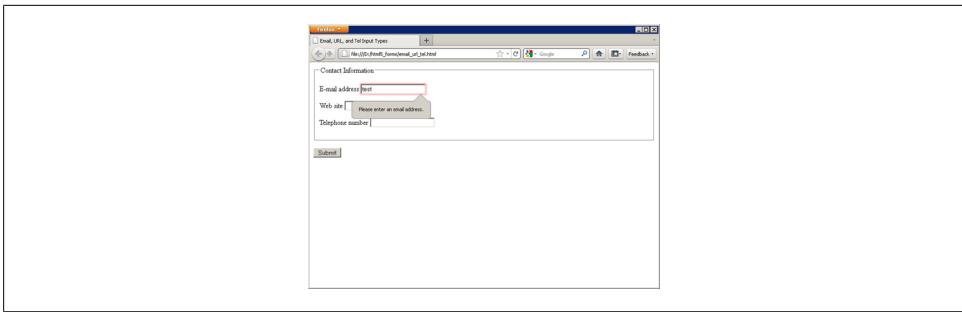


Figure 3-3. The email input field error messaging in Firefox 4.

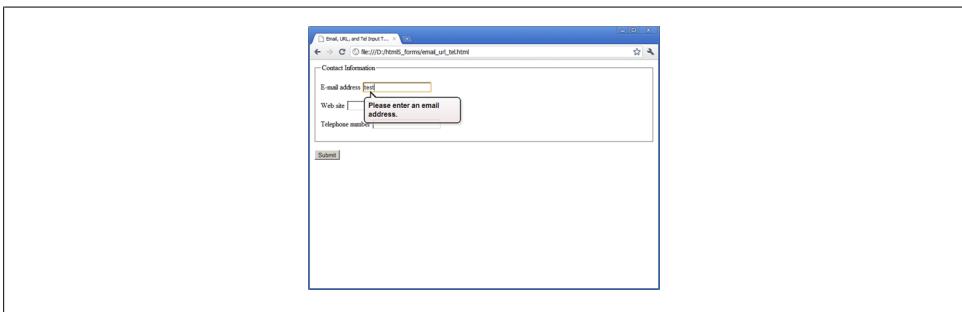


Figure 3-4. The email input field error messaging in Chrome 12

```
<p><label>Web site <input type="url" name="website"></label></p>
<p><label>Telephone number <input type="tel" name="phone"></label></p>
</fieldset>
<p><button type="submit">Submit</button></p>
</form>
```

## Discussion

How many times have you created text input fields to collect data like an email address, and then had to write JavaScript to validate the input? You won't have to do this with the new `email` and `url` input types.

These restrict the value to a valid email address or absolute URL. If the user enters a value that is not valid then the user agent warns the user and the form data is not submitted (see [Figure 3-3](#) through [Figure 3-6](#) for examples of this across various browsers).

The `tel` input type does not enforce any particular syntax, due to the variety of telephone number formats used around the world. The new `pattern` attribute can be used to enforce a particular syntax, however. For more information, see Recipe 4.12, Restricting values.

User agents vary in terms of the feedback provided to the user as they complete the form.

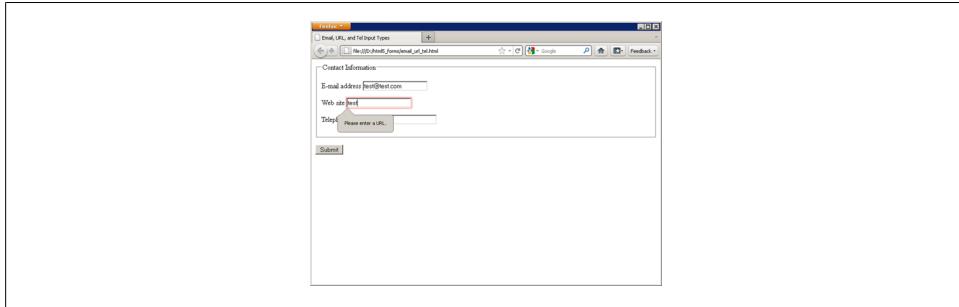


Figure 3-5. The url input field error messaging in Firefox 4

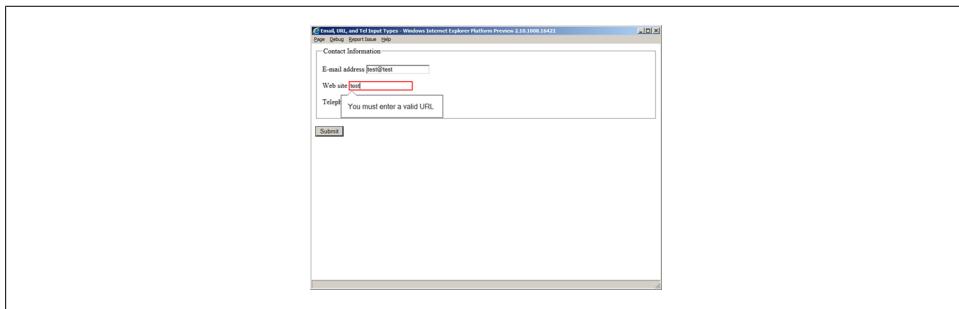


Figure 3-6. The url input field error messaging in the second Internet Explorer Platform Preview

At the time of this writing, some browsers are starting to visually highlight fields that do not validate on blur when the user exits the input field, but do not display the error message until the form is submitted.

Other browsers provide no feedback until the form is submitted.

See [Table 3-2](#) for a browser support chart.

### Customizing the default error message

Look closely at [Figure 3-5](#) and [Figure 3-6](#) and notice that the default error message varies from browser to browser. You can specify your own language by adding a title attribute to each input field.

```
<input type="url" name="website" title="That doesn't look like a valid web address.">
```

Like search, it's visually difficult to determine whether or not a user agent supports email, url, or tel. Mike Taylor's support test at <http://www.miketaylr.com/code/input-type-attr.html> is useful here, too. Browsers that do not support these new input type display a text input field.

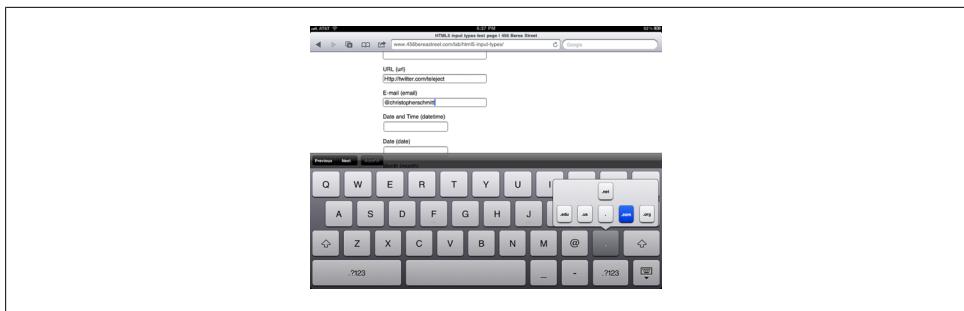


Figure 3-7. Ampersand and TLD are easily in reach on iPad keyboard

Table 3-2. Email, url, and telephone input types support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	4.0+	10+	4.0+	11.0+	✓	✓

On some touch-screen devices, the user agent will display a custom on-screen keyboard for these fields. For example, if the email input field is selected, the keyboard shows not only letters but also the ampersand ,@, and a period as seen in Figure 3-7. Cool, huh?

## See Also

For more about on-screen keyboard configurations for these fields, see Mark Pilgrim's *Dive Into HTML 5* online book at <http://diveintohtml5.org/forms.html#type-email> and <http://diveintohtml5.org/forms.html#type-url>.

## Utilizing Date and Time Input Fields

### Problem

You want to provide a user with a form to specify a date and/or time – for example, when scheduling an appointment.

### Solution

HTML 5 provides a number of new input types to assist in date and time entry.

This first solution uses the input element with HTML5 type value of `datetime` to display both a date-picker widget and time spinner control in combination as shown in Figure 3-8.

```
<form>
  <p><label>Appointment Date and Time <input type="datetime" name="dateAndTime"></label></p>
```

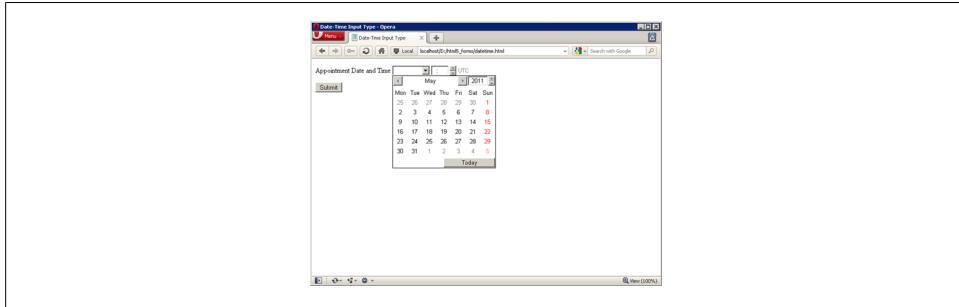


Figure 3-8. The `datetime` input field renders a date-picker widget and time spinner control in Opera 11.50.

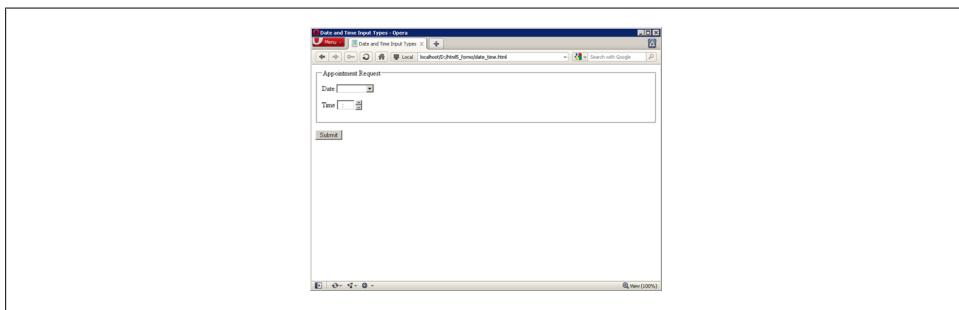


Figure 3-9. Date and time input fields in Opera 11.

```
<p><button type="submit">Submit</button></p>
</form>
```

To present the date and time input fields separately, use separate input fields with the HTML5 type values `date` and `time` as shown in [Figure 3-9](#) and [Figure 3-10](#).

```
<form>
  <fieldset>
    <legend>Appointment Request</legend>
    <p><label>Date <input type="date" name="date"></label></p>
    <p><label>Time <input type="time" name="time"></label></p>
  </fieldset>
  <p><button type="submit">Submit</button></p>
</form>
```

## Discussion

The `datetime`, `date` and `time` family of input types, which also includes `month`, `week`, and `datetime-local`, are excellent proof that new features in HTML 5 are based on what web designers and developers have been doing for years with various JavaScript libraries and other solutions.

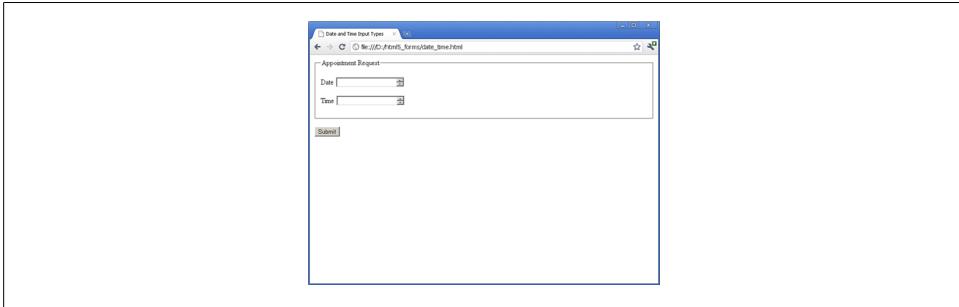


Figure 3-10. Date and time input fields in Chrome 12.

Opera has been the leader in generating date and time controls – rendering a calendar-based date picker control for `date` and a time spinner control for `time` – and many expect other browsers to eventually follow their lead.

Webkit-based desktop browsers recently introduced support for the input types, using spinners for both. User agents that do not support these input types revert to a text input field.

For a look at the browser support for date and time input types, see [Table 3-3](#).

Table 3-3. Date and time input types support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
-	-	10+	5.0+	9.0+	✓	✓



To deliver a more consistent cross-browser experience, see section 4.13, Making HTML5 work in older browsers.

Like all other form inputs, you can specify a value to be displayed when the page is rendered.

The value for the `date` input type must be a valid date string, such as `2010-12-31` that represents December 31, 2010.

The value for the `time` input type must be a valid time string, such as `23:59:59` that represents 11:59 PM, one second before midnight.

Meanwhile, the value for the `datetime` input type must be a valid global date and time string, such as `2010-12-31T23:59:59Z` that represents one second before midnight UTC on December 31, 2010.

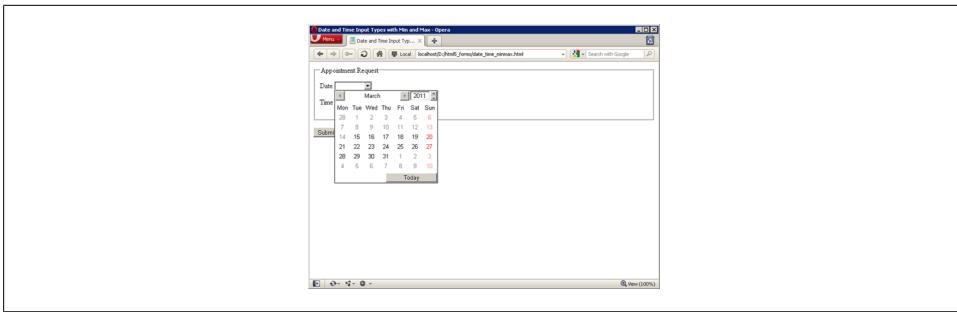


Figure 3-11. Dates prior to March 15, 2011 are not selectable when the `min` attribute is used in Opera 11.50.

### Additional Features

Two new input element attributes, the `min` and `max` attributes, can limit the range of dates and times that users can select. This is useful in cases where you don't want users to select appointment dates or times in the past or select birthdates in the future as shown in [Figure 3-11](#).

```
<form>
  <fieldset>
    <legend>Appointment Request</legend>
    <p><label>Date <input type="date" name="date" min="2011-03-15" max="2012-03-14"></label></p>
    <p><label>Time <input type="time" name="time" min="08:00" max="18:00"></label></p>
  </fieldset>
  <p><button type="submit">Submit</button></p>
</form>
```

### See Also

For more information on valid date and time values, see the HTML5 specification at <http://www.w3.org/TR/html5/common-microsyntaxes.html#dates-and-times..>

## Number Inputs

### Problem

You want to present a user with a form to enter a number, for example, to enter the quantity of an item in an order form.

### Solution

Use the input element with HTML5 type value of `number`.

```
<form>
  <p><label>Quantity <input type="number" name="quantity"></label></p>
```

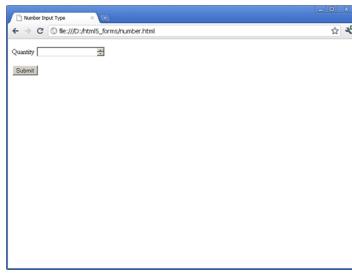


Figure 3-12. A number spinner control in Chrome 12.

```
<p><button type="submit">Submit</button></p>
</form>
```

## Discussion

As you may have guessed, the `number` input type restricts the value to a valid number – a floating point number, to be specific.

If the user enters a value that is not valid then the user agent warns the user and the form data is not submitted as shown in [Figure 3-12](#).

Some user agents display this form field with a spinner control next to the field, while others do not. On some touch-screen devices, the user agent displays a numeric on-screen keyboard for this field.

For browser support reference on `number` input type, see [Table 3-4](#).

Table 3-4. Number input type support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	-	10+	4.0+	9.0+	✓	✓

## User Friendly Input Fields

As always, it's important to think through the user experience when implementing the `number` input type.

For example, if you asking for a U.S. Zip Code using the `number` input type, presenting a spinner control might confuse the user, since its purpose isn't well known yet. On the other hand, you can't rely on all browsers displaying a spinner, so take care in crafting instructional text – don't reference the spinner arrows, in case they're not there!

Load Mike Taylor's support test (see <http://www.miketaylr.com/code/input-type-attr.html>) to determine what level of support a particular browser has for this input type. If a user agent does not recognize the `number` input type, it will display a text input field.

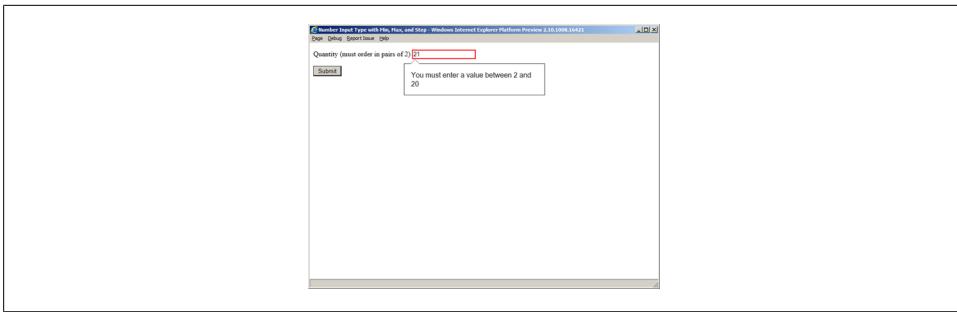


Figure 3-13. Internet Explorer 10 Platform Preview 2 uses a text entry field for the number input type, but honors the min, max, and step attributes and will display an error if necessary.

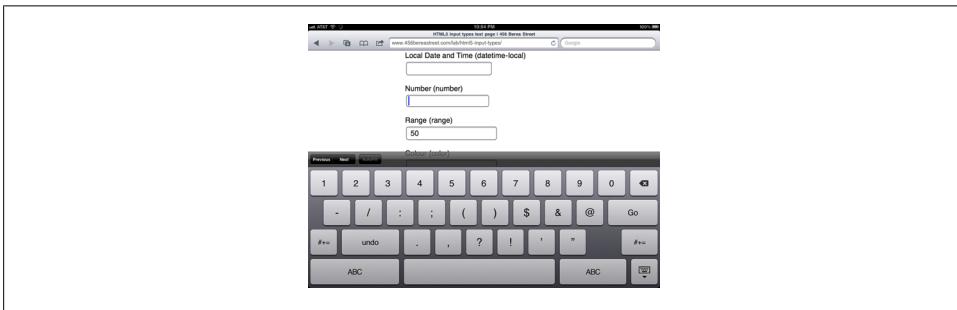


Figure 3-14. The number keyboard is displayed when number is the input value

## Additional Features

The `min` and `max` attributes can be used with the number input type to limit the values that can be entered. In addition, you can use the `step` attribute to specify the amount by which the value should be incremented. In this example, a customer must order in pairs, so the minimum quantity is 2 and the step value is 2 as shown in Figure 3-13.

```
<form>
  <p><label>Quantity (must order in pairs of 2) <input type="number" name="quantity" min="2" max="20"
  <p><button type="submit">Submit</button></p>
</form>
```

For a screen shot of an on-screen keyboard configuration for `number`, see Figure 3-14.

## See Also

See Mark Pilgrim's write up on input number at <http://diveintohtml5.org/forms.html#type-number..>

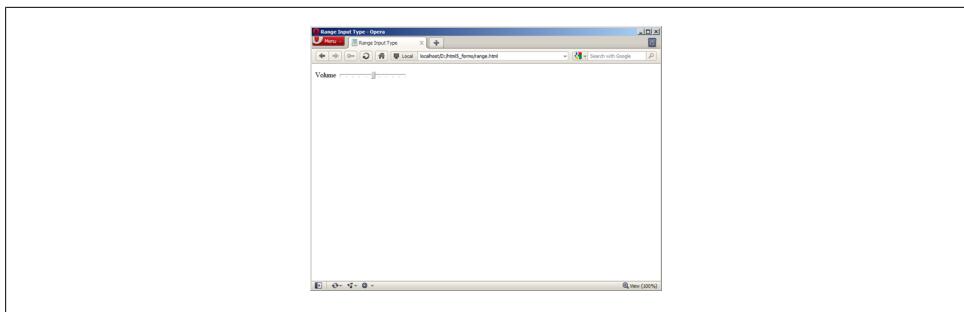


Figure 3-15. The range input type in Opera 11.50.

## Selecting From a Range of Numbers

### Problem

You want to present a user with a form to select a number from a range – for example, to adjust the volume on a video.

### Solution

Use the input element with HTML5 type value of `range`.

```
<form>
  <p><label>Volume <input type="range" name="volume" min="0" max="10" step=".5" value="5"></label></p>
</form>
```

### Discussion

The `range` input type is like `number` in that it restricts the value to a valid floating-point number, but it has the added caveat that the exact value is not important.

Exact values are important on product order forms, for values like quantity, so `number` should be used in those cases. The `range` input type is useful in cases of relative or subjective input, such as assigning a rating to an event or product.

To emphasize this point, the specification requires that the control be rendered as a slider or similar control as shown in [Figure 3-15](#).

Webkit-based browsers and Opera render a horizontal slider control for the `range` input type.

If a user agent does not recognize this input type, it displays a text input field instead.

For browser support reference on input type support, see [Table 3-5](#).

Table 3-5. Range input type support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
-	-	10+	4.0+	10.0+	✓	✓



To deliver a more consistent cross-browser experience, see section 4.13, Making HTML5 work in older browsers.

## Additional Features

Like the `number` input type, you can specify minimum and maximum values using the `min` and `max` attributes, and an increment value using the `step` attribute. These could be used with `range` to replace the radio buttons commonly used for scaled ratings, such as satisfaction rankings.

## See Also

The W3C specification on `range` at <http://www.w3.org/TR/html-markup/input.range.html>.

# Selecting Colors

## Problem

You want to present a user with a form to select a color – for example, to customize the look of a web page.

## Solution

Use the `input` element with HTML5 type value of `color`.

```
<form>
  <p><label>Background color <input type="color" name="bg"></label></p>
  <p><label>Foreground color <input type="color" name="fg"></label></p>
  <p><button type="submit">Submit</button></p>
</form>
```

## Discussion

The `color` input type restricts the value to a valid RGB value in hexadecimal format including the number sign or octothorpe, “#”, displayed before the six digits.

The HTML 5 specification prescribes a color well control for this input type, but so far only Opera has implemented this control.

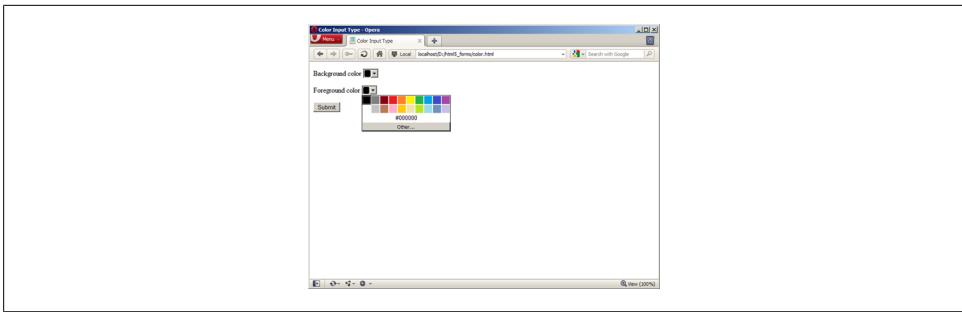


Figure 3-16. The color input type in Opera 11.50

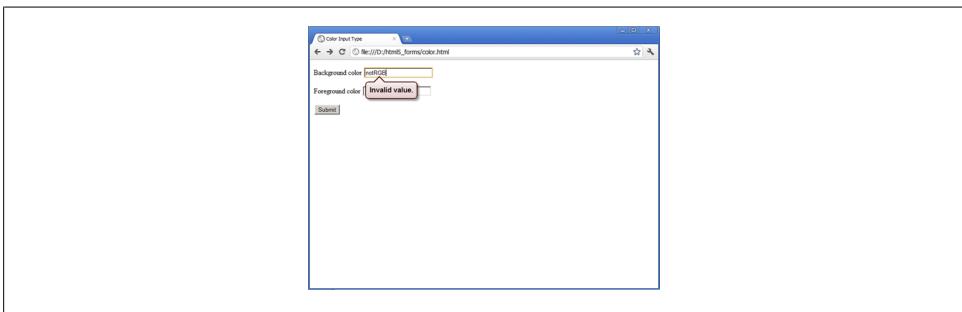


Figure 3-17. The color input type in Chrome 12.

Webkit-based browsers that support `color`, like Chrome and Safari, render a text input field but successfully validate entries and prohibit form submission if the value is not valid as shown in [Figure 3-16](#) and [Figure 3-17](#).

If a user agent does not support the `color` input type, it will display a text input field instead.

For browser support of input color value, see [Table 3-6](#).

Table 3-6. Color input type support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
-	-	10+	5.0+	11.0+	✓	✓



To deliver a more consistent cross-browser experience, see section 4.13, Making HTML5 work in older browsers.

## See Also

The word “octothorpe” is a good word and bears repeated mention in polite company; see <http://en.wiktionary.org/wiki/octothorpe>.

# Creating an Editable Drop-down

## Problem

You want to give the user the ability to enter text but also prompt her with some suggestions to choose from. This is sometimes known as an editable drop-down or a combo box.

## Solution

Use the HTML5 `datalist` element to create a list of suggestions using the `option` element, and associate the list with an `input` element via the `list` attribute.

```
<form>
  <p><label>Donation amount <input type="text" name="donation" list="donations"></label></p>
  <datalist id="donations">
    <option value="10.00">10.00</option>
    <option value="25.00">25.00</option>
    <option value="50.00">50.00</option>
  </datalist>
  <p><button type="submit">Submit</button></p>
</form>
```

## Discussion

The `datalist` element is used to define a list of suggested values for other input controls – it is not a form input or control itself.

The suggested values are specified using `option` elements, just as they would be for a `select` element, but nothing renders on screen until the `datalist` is associated with an `input` element.

Binding of a `datalist` to an input field is done by specifying an `id` on the `datalist` and using this as the value of the `list` attribute on the `input` element.

The result is a control that both accepts user input and presents a list of options for the user to choose from. This is not unlike the type-ahead or autocomplete functionality implemented in many browsers or on most search web sites as shown in [Figure 3-18](#) and [Figure 3-19](#).

For browsers that have not yet implemented `datalist`, the above solution results in the display of the text input field, but not the list of suggestions.

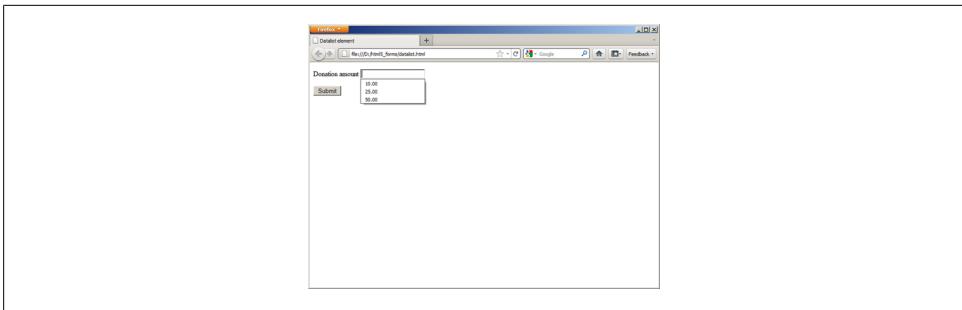


Figure 3-18. An editable drop-down rendered using `input` and `datalist` in Firefox 4.

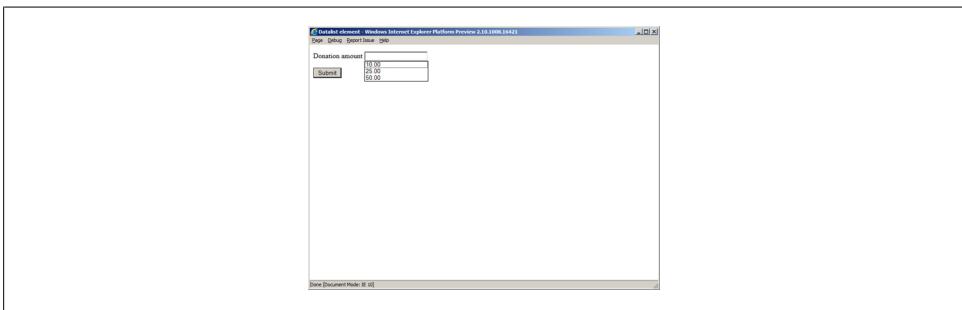


Figure 3-19. An editable drop-down rendered using `input` and `datalist` in Internet Explorer 10 Platform Preview 2.

In a few cases, older browsers may display the option labels.

For a reference on `datalist` browser support, see [Table 3-7](#).

Table 3-7. *Datalist element support.*

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	4.0+	-	-	10.0+	-	-

### datalist Workaround

Web developer Jeremy Keith has proposed the following implementation, which works with both modern browsers that support the HTML5 `datalist` element and those that do not.

The result is valid, semantic, and elegant: in the former case, the editable drop-down is rendered, but in the latter case, a select drop-down is rendered next to the text input field as shown in [Figure 3-20](#).

```
<form>
  <p><label for="donation">Donation amount</label>
  <datalist id="donations">
    <select name="donation">
```

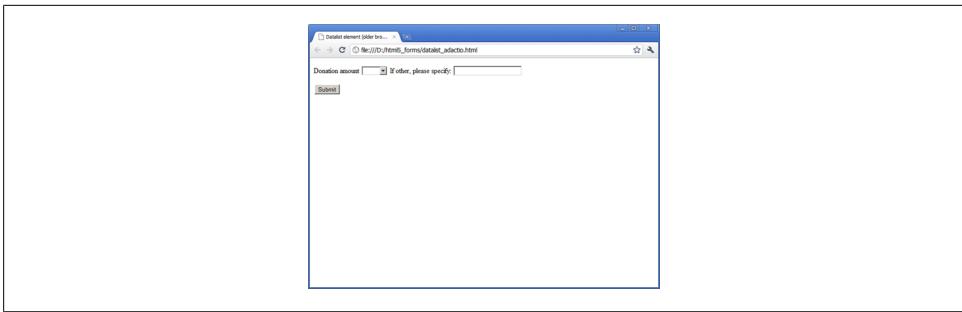


Figure 3-20. Jeremy Keith's `datalist` fallback solution in Chrome 12.

```
<option></option>
<option value="10.00">10.00</option>
<option value="25.00">25.00</option>
<option value="50.00">50.00</option>
<option>Other</option>
</select>
If other, please specify:
</datalist>
<input type="text" id="donation" name="donation" list="donations"></p>
<p><button type="submit">Submit</button></p>
</form>
```

## See Also

Read Jeremy Keith's full post on the `datalist` solution at <http://adactio.com/journal/4272/>. For updated information on `datalist` support, see <http://caniuse.com/datalist>.

# Requiring a Form Field

## Problem

You want to require a form field's completion prior to form submission.

## Solution

Apply the HTML5 `required` attribute on any form field that must be completed in order to submit the form.

```
<form>
  <fieldset>
    <legend>Login</legend>
    <p><label>Username <input type="text" name="username" required></label></p>
    <p><label>Password <input type="password" name="pwd" required></label></p>
  </fieldset>
  <p><button type="submit">Submit</button></p>
</form>
```

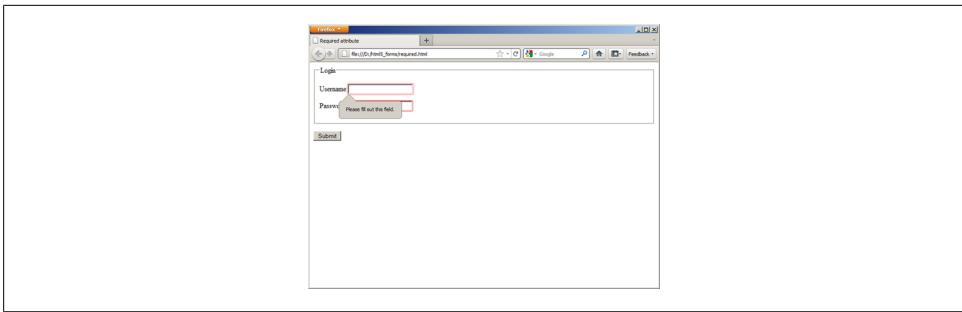


Figure 3-21. Required attribute error messaging in Firefox 4.

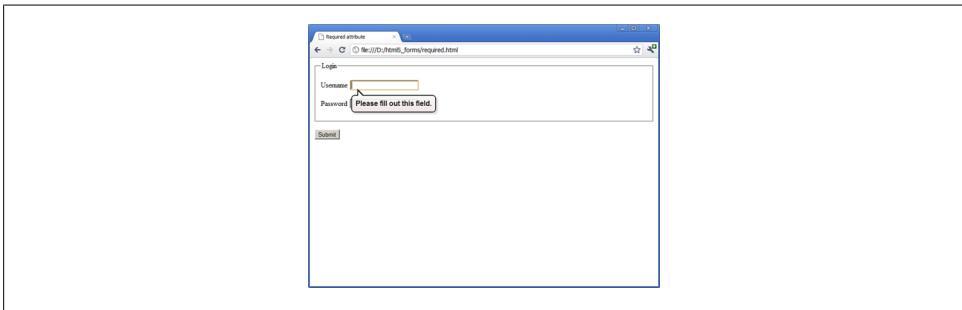


Figure 3-22. Required attribute error messaging in Chrome 12.

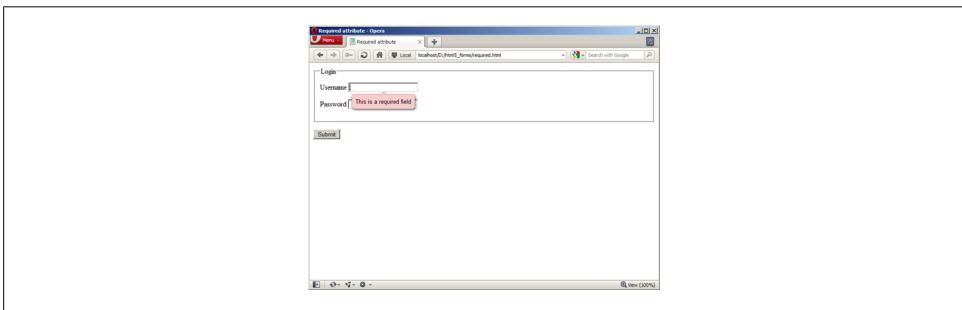


Figure 3-23. Required attribute error messaging in Opera 11.5.

## Discussion

The **required** attribute may be specified on zero or more form elements in a form.

When the user submits the form, any required field that has been left blank will cause the browser to stop the submission and an error message will be displayed.

The visual display of the error varies from browser to browser as shown in Figure 3-21 to Figure 3-25.

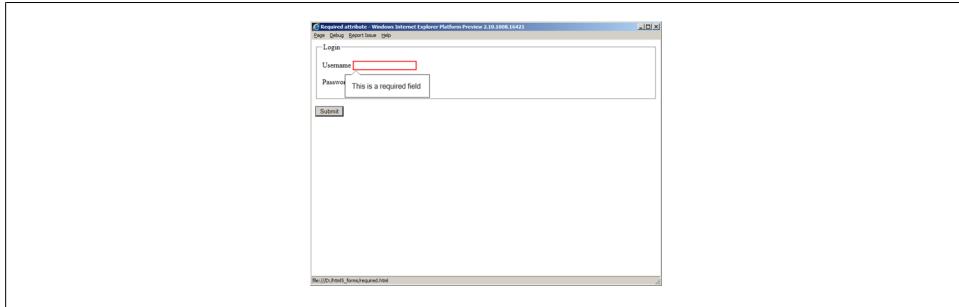


Figure 3-24. Required attribute error messaging in IE 10 Platform Preview 2

If a user agent does not recognize the `required` attribute, it will be ignored.

You can still craft JavaScript to perform this validation, using this attribute, however. See section 4.14 Validating form data in older browsers with JavaScript, for details.

For a reference on `required` attribute support in browsers, see [Table 3-8](#).

Table 3-8. Required attribute support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	4.0+	10+	5.0+	10.0+	✓	✓

## See Also

Check browser support for form field validation at <http://caniuse.com/form-validation>.

# Auto-focusing a Form Field

## Problem

You want to place focus in a particular form field when a page loads.

## Solution

Apply the HTML5 `autofocus` attribute to only one form field.

```
<form>
  <p><label>Search <input type="search" name="query" autofocus></label></p>
  <p><button type="submit">Submit</button></p>
</form>
```

## Discussion

Autofocus behavior on the web is alternately loved or hated.

It's great when the search box on Google is autofocus, but it's roundly hated when a page autofocuses in a field when the user expects to scroll a page by pressing the down arrow key.

A native solution both eliminates the need to write JavaScript and is potentially more accessible.

When implementing the `autofocus` attribute, remember that it may be specified only once per *document*, not per form! To maintain accessibility, a user agent may honor a user setting or action that would override the focus action.

If a user agent does not recognize the `autofocus` attribute, it will be ignored. You can still use JavaScript to autofocus a field.

For a browser support reference of `autofocus` support, please see [Table 3-9](#).

*Table 3-9. Autofocus attribute support.*

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	4.0+	3.0+	4.0+	10.0+	✓	✓

## See Also

See section 4.14 Validating form data in older browsers with JavaScript, for details.

# Displaying Placeholder Text

## Problem

You want to display some hint or help text within a form field.

## Solution

The HTML5 `placeholder` attribute is used to specify instructional text when the user is not focused in the form field.

```
<form>
  <fieldset>
    <legend>Contact Information</legend>
    <p><label>E-mail address <input type="email" name="email" placeholder="user@domain.com"></label>
    <p><label>Web site <input type="url" name="website" placeholder="http://www.domain.com/"></label>
    <p><label>Telephone number <input type="tel" name="phone" placeholder="123-123-1234"></label></p>
  </fieldset>
  <p><button type="submit">Submit</button></p>
</form>
```

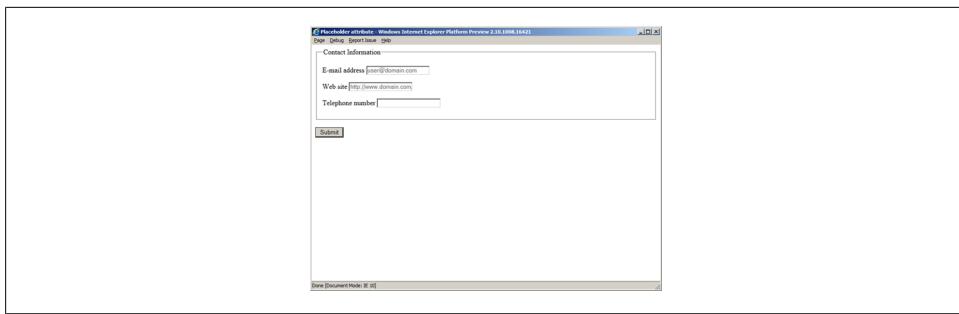


Figure 3-25. Placeholder text in Internet Explorer 10 Platform Preview 2.

## Discussion

Usability experts and user interface designers have been trying to solve the problem of displaying unobtrusive instructional text to users in forms for a long time.

In the past five years, placeholder text within an input field has become a standard design pattern, and now we have a standard way of implementing this solution.

When a `placeholder` attribute is specified on an input element, a user agent will display the value of the `placeholder` attribute in the rendered form field.

The placeholder text can then be toggled off and on, depending on which page element has focus and whether or not there is data in the form field: when the user is focused on the field, the placeholder text will disappear; if the user leaves the form field blank and leaves the field, the placeholder text will reappear as shown in [Figure 3-25](#).

While the `placeholder` attribute helps make a form more useable, its purpose is to provide an additional hint to the user. Do not omit the `label` element, which properly captions a form control.

If a user agent has not implemented support for the `placeholder` attribute, the attribute will be ignored.

For a browser reference chart on `placeholder` attribute support, see [Table 3-10](#).

Table 3-10. Placeholder attribute support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	4.0+	4.0+	4.0+	11.0+	✓	✓

## See Also

To deliver a more consistent experience to both browsers that support it and those that do not, see Recipe 3.1e, Making HTML5 Work in Older Browsers.

# Disabling Autocomplete

## Problem

You want to prevent autocomplete tools from populating a form field.

## Solution

Set the HTML5 `autocomplete` attribute to “off” for any individual input field, such as a password field.

```
<form>
  <fieldset>
    <legend>Login</legend>
    <p><label>Username <input type="text" name="username"></label></p>
    <p><label>Password <input type="password" name="pwd" autocomplete="off"></label></p>
  </fieldset>
  <p><button type="submit">Submit</button></p>
</form>
```

## Discussion

The `autocomplete` attribute was introduced by Microsoft Internet Explorer in 1999 and was adopted by other browsers, although it was not part of any previous HTML or XHTML specification.

By default, `autocomplete` is enabled (`on`) for all form fields. You may currently rely on your browser’s ability to remember your passwords and autocomplete functionality to log in to many of the web sites you visit.

If, however, you specify a value of `off` for this attribute, you will disable this functionality.

In addition to disabling `autocomplete` at the individual input field level, you can also disable it at the form level. If you disable `autocomplete` at the form level, you can re-enable it for an individual form field by setting `autocomplete="on"`.

While many security experts suggest applying `autocomplete="off"` to form fields that contain sensitive data, you should keep in mind that this is *not* a particularly effective security measure.

Some browsers do not yet support `autocomplete` and since so many tools exist to circumvent `autocomplete="off"` – tools that still auto-inject a user’s stored password – it’s often security theater or simply a false security measure.

Those browsers that do not support `autocomplete` simply ignore the attribute altogether.

For a browser support reference on `autocomplete` support, see [Table 3-11](#).

Table 3-11. Autocomplete attribute support.

IE	Firefox	Chrome	Safari	Opera	iOS	Android
Yes*	4+	Yes*	Yes*	10.0+	Yes*	Yes*



In table 3-11, “yes” indicates that the browser has implemented auto complete in a pre-HTML 5, non-standard way. Use Mike Taylor’s input and attribute support page at <http://www.miketaylr.com/code/input-type-attr.html> to determine when a browser has implemented it per the HTML 5 standard.

## See Also

The autocomplete attribute in the WHATWG HTML specification at <http://www.whatwg.org/specs/web-apps/current-work/multipage/forms.html#attr-form-autocomplete>.

# Restricting Values

## Problem

You want to restrict the value of an input field according to a set of rules you specify.

## Solution

Use the HTML5 pattern attribute to specify a regular expression that will be used to validate the user’s input.

```
<form>
  <p><label>Telephone number <input type="tel" name="phone" pattern="[2-9][0-9]{2}-[0-9]{3}-[0-9]{4}">
  <p><button type="submit">Submit</button></p>
</form>
```

## Discussion

For years, web professionals have been writing validation scripts to check user data prior to form submissions – and likely most of us would say that we have hated it.

With HTML 5, we have a method for checking form input that doesn’t rely on Java-Script: regular expressions.

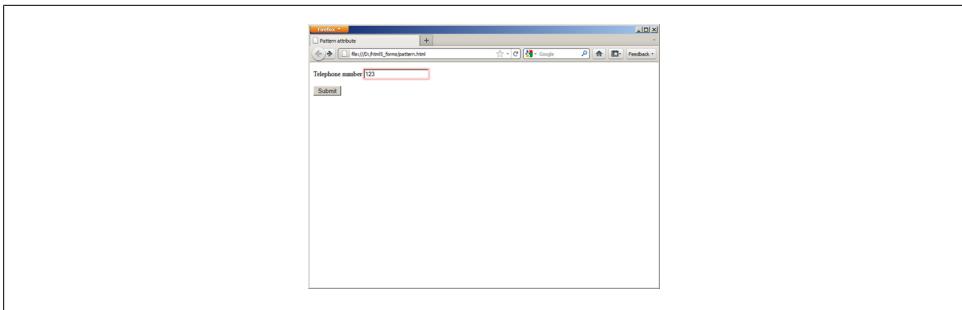


Figure 3-26. Pattern mismatch on blur of input field in Firefox 4. An error “bubble”, similar to those seen elsewhere in this chapter, will be displayed on form submit.

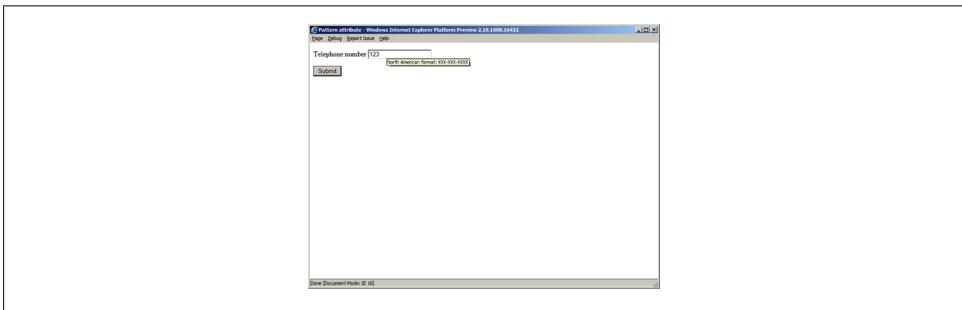


Figure 3-27. Title rendered as tooltip in Internet Explorer 10 Platform Preview 2.



Regular expressions are very powerful and fun to write, once you get the hang of them. You don't need to pour over a big book like *Mastering Regular Expressions*. Instead, the *Regular Expressions Cookbook* will help you to figure out how to define some common expressions. Then you'll be ready for that big book in no time.

The HTML5 **pattern** attribute allows you to specify a regular expression for an input field. On blur of the input field or on submit of the form (browser implementations vary), the user's input will be validated against the pattern, and if it does not match, an error will be displayed and the form will not be submitted as shown in Figure 3-26.

Regular expressions for **pattern** must use the same syntax as in JavaScript. Keep in mind that the **pattern** attribute must match the entire value or else the user will see the error messaging.

When the **pattern** attribute is used, you should also specify a **title** attribute to describe the pattern. The user agent may display this text to the user as a tooltip or as an error if the submitted value does not match the pattern as shown in Figure 3-27.

If a user agent cannot compile the regular expression, it is ignored and no validation will happen on that input. If a user agent does not recognize the `pattern` attribute, it, too, is ignored.

For a browser reference chart for `pattern` attribute support, see [Table 3-12](#).



To deliver a more consistent cross-browser experience, see section 4.14, Validating form data in older browsers with JavaScript.

*Table 3-12. Pattern attribute support.*

IE	Firefox	Chrome	Safari	Opera	iOS	Android
10 Platform Preview 2	4+	10+	5+	11+	-	-

## See Also

Just as with the `required` attribute, to keep up with browser support for `pattern` check <http://caniuse.com/form-validation>. For a list of commonly used regular expressions, see [http://html5pattern.com/..](http://html5pattern.com/)

# Making HTML5 Work in Older Browsers

## Problem

You want to make HTML5 input types and attributes work in browsers that do not support HTML5.

## Solution

Use the Modernizr JavaScript library (see <http://www.modernizr.com>) to detect support for specific HTML5 attributes, then develop or use alternate solutions, such as jQuery UI (see <http://jqueryui.com>) for instances where features are not supported.



Modernizr is a small, open-source JavaScript library that detects native implementations of HTML5 and CSS3 features in browsers. Instead of performing browser detection in order to determine support, Modernizr performs individual feature detection. Modernizr is a very reliable way to detect support for HTML5 form features.

jQuery UI is a library of user interface design pattern implementations. It is based on and requires the jQuery JavaScript library, which is used by many of the top sites on the web, including Google, Amazon, Twitter, and Microsoft. jQuery makes manipulating the DOM easy, and jQuery UI gives you easy to implement, themeable widgets.

### Example 1: Supporting the `autofocus` attribute

Save Modernizr locally and call it in the `head` of your document.

```
<head>
    <script src="modernizer.js"></script>
</head>
```

Code your form using the `autofocus` attribute.

```
<form>
    <p><label>Search <input type="search" name="query" id="query" autofocus></label></p>
    <p><button type="submit">Submit</button></p>
</form>
```

Write a script to detect support for `autofocus` and, if not available, use JavaScript to focus on the element. This script can appear immediately after your form, to trigger the focus event as quickly as possible.

```
<script>
    if (!Modernizr.input.autofocus) {
        document.getElementById("query").focus();
    }
</script>
```

### Example 2: Supporting the `placeholder` attribute

Call Modernizr and jQuery in the `head` of your document.

```
<head>
    <script src="modernizer.js"></script>
    <script src="jquery.js"></script>
</head>
```

Code your form using the `placeholder` attribute.

```
<form>
    <p><label>Search <input type="search" name="query" id="query" value="" placeholder="Enter query"></p>
    <p><button type="submit">Submit</button></p>
</form>
```

Write a script to detect support for `placeholder` and, if not available, use JavaScript to toggle the display of the placeholder text in the input field.

```

<script>
    if (!Modernizr.input.placeholder) {
        $("#query").focus(function() {
            if ($("#query").val() == $("#query").attr('placeholder')) {
                $("#query").val("");
            }
        });
        $("#query").blur(function() {
            if ($("#query").val() == "") {
                $("#query").val($("#query").attr('placeholder'));
            }
        });
        $("#query").blur();
    }
</script>

```

Even if you've never seen jQuery before, the above code is probably very easy to read.

jQuery uses CSS selector syntax to refer to elements in the DOM, so `$("#query")` refers to the search input field with an id of query. The `focus` and `blur` methods are chained on to the search field, thus creating event handlers for when the field gains and loses focus.

When the blur event is triggered, the value (`val`) of the search field is set to the placeholder attribute value, provided the value was empty.

When the focus event is triggered, the value of the search field is set to an empty string – but only if the previous value was the same as the placeholder attribute text.

This script can appear immediately after the form, or it can be combined with other scripts at the bottom of the `body` of your document.

### **Example 3: Supporting the date input type**

Call Modernizr, jQuery, and jQuery UI in the `head` of your document. (Don't forget the CSS for jQuery UI!)

```

<head>
    <script src="modernizr.js"></script>
    <script src="jquery.js"></script>
    <script src="jquery-ui.js"></script>
    <link href="jquery-ui.css" rel="stylesheet">
</head>

```

Code your form using the date input type.

```

<form>
    <p><label>Date of Birth <input type="date" name="dob" id="dob"></label></p>
    <p><button type="submit">Submit</button></p>
</form>

```

Write a script to detect support for `date` and, if not available, trigger jQuery UI's date picker widget.

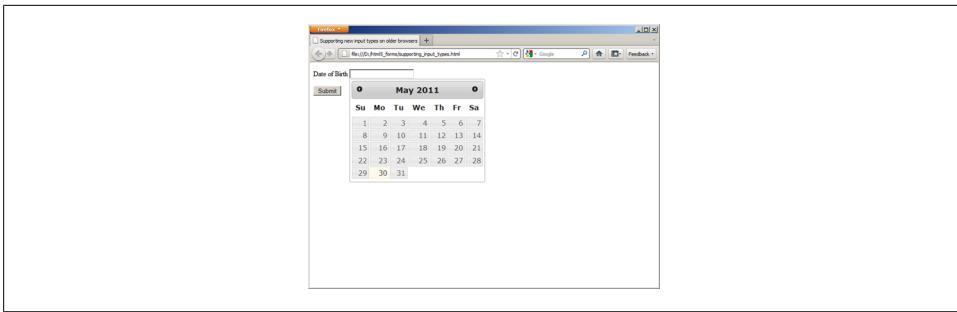


Figure 3-28. *jQuery UI date picker is triggered since Firefox 4 does not support the date and time input types.*

```
<script>
  if (!Modernizr.inputtypes.datetime) {
    $("#dob").datepicker();
  }
</script>
```

I bet you’re surprised at how little code is needed for this example, as compared to the previous one! This is the beauty of adopting a reusable solution, like jQuery UI. The following is the result for a browser that does not natively support the `date` input type as shown in [Figure 3-28](#).

Like the previous example, this script can appear immediately after the form, or it can be combined with other scripts at the bottom of the `body` of your document.

## Discussion

Remember that the new input types in HTML 5 are derived from the solutions that developers have been creating with HTML and JavaScript for quite a while – so it is fairly easy to find UI libraries that provide substitute functionality for browsers that do not yet support HTML 5 forms.

In the future, when all of your users have upgraded to browsers that support HTML 5 elements, input types, and attributes, notice that you’ll be able to quickly and easily remove the scripts without needing to change your markup!

## See Also

For additional discussion on fallback solutions, see <http://diveintohtml5.org/forms.html# autofocus>.

# Validating Form Data in Older Browsers with JavaScript

## Problem

You want to validate form data in browsers that do not support HTML5.

## Solution

Use the Modernizr JavaScript (see <http://www.modernizr.com>) library to detect support for specific HTML5 attributes and script alternate solutions when features are not supported. (Refer back to section 3.13, Making HTML 5 work in older browsers, for information on Modernizr and other JavaScript libraries.)

Save Modernizr locally and call it in the head of your document. I'm also calling jQuery (se <http://www.jquery.com>) to make it easy to reference the `form` element and to attach an event handler.

```
<head>
  <script src="modernizer.js"></script>
  <script src="jquery.js"></script>
</head>
```

Code your form using HTML5 form validation attributes, such as `required` and `pattern`.

```
<form>
  <fieldset>
    <legend>Login</legend>
    <p><label>Username <input type="text" name="username" required></label></p>
    <p><label>Password <input type="password" name="password" required pattern="[0-9a-zA-Z]{12}" title="12 character password"></label></p>
  </fieldset>
  <p><button type="submit">Submit</button></p>
</form>
```

Write a script to detect support for `required` and `pattern` and define alternate form handling if support is not available.

```
<script>
if (!Modernizr.input.required || !Modernizr.input.pattern) {
  ('form').submit(function() {
    var validData = true;
    $('[required], [pattern]').each(function() {
      if (((this).attr('required') !== false) && ((this).val() == "")){
        $(this).focus();
        alert("The " + $(this).attr('name') + " field is required!");
        validData = false;
        return false;
      }
      if ($(this).attr('pattern')){
        var regexp = new RegExp($(this).attr('pattern'));
        if (!regexp.test($(this).val())){
          $(this).focus();
          alert("The data in the " + $(this).attr('name') + " field isn't in the right format!");
        }
      }
    })
  })
}
```

```

        validData = false;
        return false;
    }
})
return validData;
});
}
</script>

```

## Discussion

We've been validating forms with JavaScript for about fifteen years, so there are plenty of ways to require form field completion and to validate data. What's new about this solution is that it leverages the HTML5 form attributes `required` and `pattern` to establish the rules for validation, and the JavaScript simply keys off of them. In the recent past, developers have used the `rel` attribute to perform a similar style of validation, but this is no longer necessary (nor is it valid HTML 5).

Again, when all of your users have upgraded to browsers that natively support HTML 5 form validation, you'll be able to quickly and easily remove the scripts without needing to change your markup.

## Example: Sample Form

### Problem

You want to present a user with an appointment scheduling form, for example, for scheduling a doctor's appointment.

### Solution

```

<!DOCTYPE html>
<html>
<head>
<title>Appointment Scheduler</title>
</head>

<body>
<h1>Appointment Scheduler</h1>

<form>

<fieldset>
    <legend>Personal Information</legend>
    <p><label>Name <input type="text" name="name" required></label></p>
    <p><label>Telephone number <input type="tel" name="phone" required pattern="[\d]{2}[\d]{3}-[\d]{4}"></label></p>
    <p><label>E-mail address <input type="email" name="email"></label></p>
    <p><label>Date of birth <input type="date" name="dob"></label></p>

```

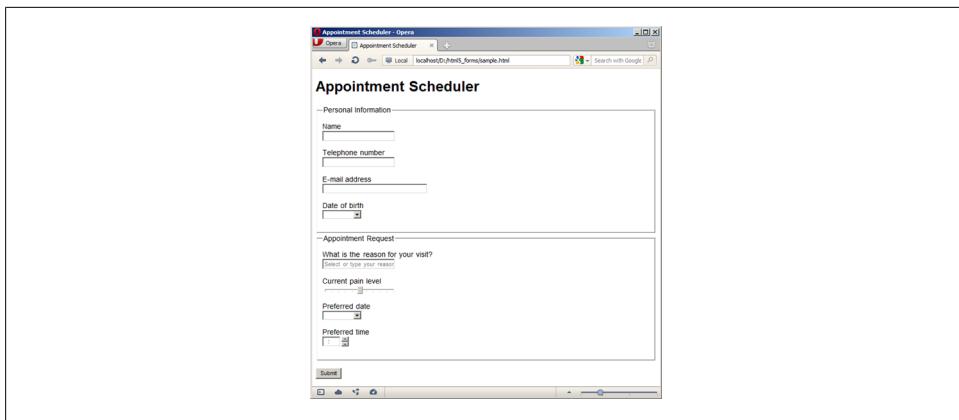


Figure 3-29. The sample form, with basic styling, in Opera 11.5.

```
</fieldset>

<fieldset>
    <legend>Appointment Request</legend>
    <p><label for="reason">What is the reason for your visit?</label>
    <datalist id="reasons">
        <select name="reason">
            <option>Annual physical</option>
            <option>Cold or flu symptoms</option>
            <option>Blood test</option>
            <option>Post-operative</option>
            <option>Other</option>
        </select>
        If other, please specify:
    </datalist>
    <input id="reason" name="reason" list="reasons"></p>
    <p><label>Current pain level <input type="range" name="pain" min="0" max="10" step=".5" value="5"></label>
    <p><label>Preferred date <input type="date" name="date" required min="2011-03-15" max="2012-03-15"></label>
    <p><label>Preferred time <input type="time" name="time" required min="08:00" max="18:00" step="1"></label>
</fieldset>

<p><button type="submit">Submit</button></p>
</form>

</body>
</html>
```

## Discussion

This is the future of form markup, my friends! When rendered in a browser that fully supports HTML 5 forms, the only thing this form will want for is some CSS – no JavaScript necessary! It will render nicely across a variety of devices and be much more accessible than what we use today, as shown in [Figure 3-29](#).

When will we have full support in the majority of browsers for HTML 5 forms? Opera is leading the way in support, but Firefox and Chrome are on rapid release cycles and are catching up quickly.

The second Internet Explorer Platform Preview was released during the writing of this chapter and it, too, shows good progress.

# Native Audio

*Emily Lewis*

## Introduction

You already deal with *embedded content*—content that is imported or inserted into a web page—almost every day (see <http://www.w3.org/TR/html5/content-models.html#embedded-content-0>). Think about the `img` element. It inserts content, the image, into your web page via the `src` attribute.

With HTML5, we now have many more options for embedded content, including native audio via the new `audio` element (see <http://dev.w3.org/html5/markup/audio.html>).

Native? Yes. That means no more ungainly `object` and `embed`. No more need to deliver audio with a third-party plugin and, as such, no more design headaches with dynamic layouts or dropdown menus.

With `audio` in our arsenal, we not only can deliver audio files directly through the browser, but we can style and manipulate the element and its attributes via CSS and JavaScript.

## Adding HTML5 Audio

### Problem

You want to play native audio on your web page.

### Solution

Add the `audio` element, with the `src` attribute referencing the file location of your audio file and fallback content for older browsers:



Figure 4-1. Default audio controls in Chrome 9 include play/pause, progress bar and volume/mute.

```
<audio src="audio.ogg" controls>
  Download <a href="audio.ogg">episode 42 of Learning to Love HTML5</a>
</audio>
```

Also be sure to include the `controls` attribute if you want browsers to display a default control interface for your audio (see Figure 4-1):

```
<audio src="audio.ogg" controls>
```

The audio file in this example uses the Ogg Vorbis (.ogg), which is a royalty-free, open source codec (see <http://www.vorbis.com>).

There are many other audio formats for the web (see Table 4-1), which is one of the biggest challenges in implementing HTML5 audio.



A codec is a technology for compressing and decompressing data. *Audio* codecs compress and/or decompress digital audio data into different formats (see Table 4-1) that aim to retain the highest level of quality with the minimum bit rate.

## Multiple Audio Codecs

The HTML5 specification does not dictate or make any recommendations about what audio codecs should be supported.

And since it would make far too much sense for browser makers to agree (see <http://lists.whatwg.org/pipermail/whatwg-whatwg.org/2009-June/020620.html>), there isn't a single format that works in all browsers as shown in Table 4-1.

Table 4-1. Current browser support for HTML5 audio formats

Browser	AAC (.aac)	MP3 (.mp3)	Ogg Vorbis (.ogg)	WAV (.wav)	WebM (.webm)
Chrome 6+		X	X		X
Firefox 3.6+			X	X	X
IE9+	X	X		X	
Opera 10.5+			X	X	
Safari 5+	X	X		X	

.aac

Lossy compression scheme developed as an improvement over MP3, with similar bit rates but better sound quality.

.mp3

Patented yet popular format, which uses lossy compression to achieve file sizes one-tenth of non-compressed.

.ogg

An open source alternative to .mp3 that also uses a lossy compression format.

.wav

Proprietary format for audio that does not utilize any compression.

.webm

Google's open, royalty-free media format, which relies on the Vorbis audio codec for compression.

## Integrating Multiple Sources

In terms of which to choose, the reality is that if you want your content to reach the widest audience, you have to encode and include *multiple* audio files in your HTML5 **audio**.

Fortunately, HTML5 gives us a solution by enabling you to declare multiple files in your **audio** element.



When using the **source** element in **audio**, the **src** attribute is dropped. **src** only comes into play (pun intended) if you are referencing a *single* audio format.

In terms of best practices, it's recommended that you minimally include the .ogg royalty-free format *and* either the .mp3 or .wav formats.

This type of approach should cover your bases with the latest browsers:

```
<audio controls>
  <source src="audio.ogg">
  <source src="audio.mp3">
    Download <a href="audio.ogg">episode 42 of Learning to Love HTML5</a>
</audio>
```

## Preloading the Audio

**audio** has several attributes that allow you to configure your audio implementation.



For a full description of the attributes available for HTML5 media elements, see the WHATWG standard: <http://www.whatwg.org/specs/web-apps/current-work/multipage/video.html#media-element-attributes>.

The **preload** attribute allows you to hint to the browser when it should begin buffering the audio:

Figure 4-2. Fallback content display in IE8, which lacks HTML5 audio support

```
<audio controls preload>
```

While `preload` currently has limited browser support, it seems useful for optimizing the download process. You can simply specify `preload` and leave it to the browser to decide the appropriate action, or you can choose from three defined `preload` values:

`preload="auto"`

Is the same as a Boolean `preload`, and suggests that the browser should begin downloading the file, but leaves the ultimate action up to the browser. So, if it is a mobile situation or a slow connection, the browser can decide not to preload in order to save bandwidth.

`preload="metadata"`

Hints that the browser shouldn't buffer the audio itself until the user activates the controls, but metadata like duration and tracks should be preloaded.

`preload="none"`

Suggests that the audio shouldn't be downloaded until the user activates the controls.

## Discussion

In addition to the browser inconsistencies with audio formats, there is a bit of inconsistency in the support for `audio` itself. There are browser bugs, quirks and oddities that will hopefully be addressed by the browser makers, but until they are it is up to us designers and developers to remain informed.



24Ways provides a list of some of these browser issues: <http://24ways.org/2010/the-state-of-html5-audio..>

## Creating Fallback Content

As you saw in the first example of this recipe, `audio` allows us to include *fallback* content. Fallback simply means that if a user is on a browser that doesn't support HTML5 `audio`, she instead sees the fallback content (see Figure 4-2).

The HTML5 specification says that all child elements of `audio` other than `source` should be ignored. This means that your fallback content for users of older browsers won't adversely affect a user on an HTML5-capable browser.

For example, you could include fallback Flash:

```

<audio controls>
  <source src="audio.ogg">
  <source src="audio.mp3">
  <object data="player.swf?audio=audio.mp3">
    <param name="movie" value="player.swf?audio=audio.mp3">
    Video and Flash are not supported by your browser.
  </object>
</audio>

```

Or you could simply describe what the audio file contains and include a link to the file for a user to download and play on his device's media player (along with some gentle encouragement to upgrade to a new browser):

```

<audio controls>
  <source src="audio.ogg">
  <source src="audio.mp3">
  Your browser doesn't support HTML5 audio. You should upgrade. In the meantime, download <a href="au
</audio>

```

## Accessible Alternatives

Another challenge with HTML5 audio is that alternative content for multimedia doesn't quite exist in practice. *Theoretically*, accessibility would be delivered through two-steps:

- First, multimedia authors include a subtitles file in the container `.ogv` or `.mp3`.
- And then browsers would give the user an interface to access those subtitles and captions.



Using the `alt` attribute with `img` isn't a practical solution and it isn't what the HTML5 specification intends and, more importantly, assistive technologies don't process `audio` fallback content in that fashion.

For now, there's not much more than a few experimental approaches you can try:

- Accessible HTML5 Video with JavaScripted captions: <http://dev.opera.com/articles/view/accessible-html5-video-with-javascripted-captions/>
- HTML5 and Timed Media: <http://www.bbc.co.uk/blogs/rad/2009/08/html5.html>
- Demos of HTML5 Video and Audio Tag Accessibility: <http://www.annodex.net/~silvia/itext/>

You may note that some of these resources reference video. That's because `audio` and `video` are so similar, the approaches described can be applied to both (as discussed in [Chapter 5](#)).

Beyond issues with captioning, `audio` support in general is inconsistent among assistive technologies. For example, some screen readers don't recognize the element at all and simply skip it.

Further, `audio` accessibility like keyboard support, is inconsistent among browsers. As this is the case for HTML5 across the board, we recommend staying updated at <http://html5accessibility.com>.

### Intellectual Property Rights

You may have already figured out that HTML5 audio isn't a "one size fits all" solution. But it isn't just the need for multiple file formats or inconsistent browser support; *HTML5 does not offer any copy protection.*

`audio` (and `video`, see [Chapter 5](#)) is as easy to save to a user's hard drive as `img` and, therefore, isn't a good fit for all use cases. If Digital Rights Management (DRM) is needed, then a plugin, not `audio`, is likely a better solution with how copy protection stands today.

## See Also

For more about HTML5 multimedia accessibility, the W3C wiki offers an in-depth view of known issues and proposed solutions: <http://www.w3.org/html/wg/wiki/MultiMediaAccessibility>.

# Manipulating the Audio Stream

## Problem

You want to be able to control and manipulate how your HTML5 `audio` plays in the browser.

## Solution

As part of the specification, `audio` has a few attributes that give you simple and instant control over your playback:

### `autoplay`

Tells the browser to start playing the audio as soon as the page loads.



I hesitate to even mention this attribute because it does exactly what it says and is one of the most annoying, non-user-friendly things on web sites (<http://www.punkchip.com/2009/04/autoplay-is-bad-for-all-users>). So, while `autoplay` is available, don't use it. Seriously. Don't.

## loop

Another self-descriptive attribute, `loop` tells the browser to loop the audio when playing forwards.



Less offensive than the `autoplay` attribute, but one that should be used with discretion.

Like `controls`, both `autoplay` and `loop` are Boolean attributes, so you simply include them in the opening `audio` tag when you want them:

```
<audio controls loop>
```

## Discussion

But what if you want more control that these basic attributes provide? Fortunately, `audio` and `video` have attributes, events and methods you can manipulate with JavaScript to create custom controls, including:

`canplaytype(type)`

Whether the browser can play a particular type of media

`currentTime`

The current playback position denoted in seconds

`duration`

The length of the audio file in seconds

`play();`

Start playback at the current position

`pause();`

Pause playback if the audio is actively playing

For example, you want to include controls that allow the user to jump to a specific time in the audio file. You can add this functionality with a `button` and a dash of JavaScript to manipulate the `play();` method based on the read/write property `currentTime`:

```
<audio>
    <source src="audio.ogg">
    <source src="audio.mp3">
</audio>
<button title="Play at 30 seconds" onclick="playAt(30);">30 seconds</button>
<script>
    function playAt(seconds){
        var audio = document.getElementsByTagName("audio")[0];
        audio.currentTime = seconds;
        audio.play();
    }
</script>
```

There is not a stop method.

However, by using the same approach as in the example above, the stop functionality can be mimicked through the `pause()` method to return to the beginning of the audio file via `currentTime`:

```
<audio>
  <source src="audio.ogg">
  <source src="audio.mp3">
</audio>
<button title="Play at 30 seconds" onclick="playAt(30);">30 seconds</button>
<button title="Stop Audio" onclick="stopAudio();">Stop Audio</button>
<script>
  function playAt(seconds){
    var audio = document.getElementsByTagName("audio")[0];
    audio.currentTime = seconds;
    audio.play();
  }
  function stopAudio(){
    var audio = document.getElementsByTagName("audio")[0];
    audio.currentTime = 0;
    audio.pause();
  }
</script>
```



Note that when creating your own custom controls, you drop the `controls` Boolean attribute from `audio`.

For more information on creating custom controls, see “[Sample Design: Custom Audio Player](#)” on page 96.

## See Also

For a much less rudimentary approach to manipulating the audio playback with custom controls, see Opera’s “Everything You Need to Know About HTML5 Video and Audio” <http://dev.opera.com/articles/view/everything-you-need-to-know-about-html5-video-and-audio/>.

# Generating audio Using JavaScript

## Problem

You want to generate real time audio on your web page.

## Solution

You can generate audio on the browser without the `src` attribute or `source` elements by using methods defined by the Mozilla Audio Data API ([https://wiki.mozilla.org/Audio\\_Data\\_API#Writing\\_Audio](https://wiki.mozilla.org/Audio_Data_API#Writing_Audio)):

`mozSetup(channels, sampleRate)`

Defines the channels and sample rate for the generated audio stream

`mozWriteAudio(buffer)`

Writes the samples, from an array, for the generated audio

`mozCurrentSampleOffset()`

Gets the current playback position of the audio, denoted in samples

## Discussion

This particular implementation of `audio` has somewhat limited support. In fact, only Firefox 4+ and Chrome Beta currently support it. As such, it is more an experimental approach than something geared for mainstream use.

If you happen to be the experimental type, though, check out this short video presentation of what is possible with the Mozilla Audio Data API: <http://www.youtube.com/watch?v=1Uw0CrQdYYg>.

## See Also

The transcript for the “jasmid – MIDI synthesis with Javascript and HTML5 audio” talk from Barcamp London 8 provides a very high-level discussion about the challenges and practical implications of generating audio on the fly, in the browser: <http://matt.west.co.tt/music/jasmid-midi-synthesis-with-javascript-and-html5-audio/>.

# Visualizing audio Using canvas

## Problem

You want to create a visualization of your HTML5 `audio` using `canvas`.

## Solution

```
<audio src="audio.ogg"></audio>
<canvas width="512" height="100"></canvas>
<button title="Generate Waveform" onclick="genWave();">Generate Waveform</button>

<script>
    function genWave(){
        var audio = document.getElementsByTagName("audio")[0];
```

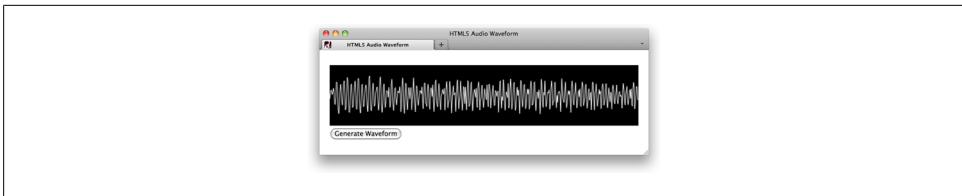


Figure 4-3. Wave visualization of audio via canvas in Firefox 5

```
var canvas = document.getElementsByTagName("canvas")[0];
var context = canvas.getContext('2d');
audio.addEventListener("MozAudioAvailable", buildWave, false);
function buildWave (event){
    var channels = audio.mozChannels;
    var frameBufferLength = audio.mozFrameBufferLength;
    var fbData = event.frameBuffer;
    var stepInc = (frameBufferLength / channels) / canvas.width;
    var waveAmp = canvas.height / 2;
    canvas.width = canvas.width;
    context.beginPath();
    context.moveTo(0, waveAmp - fbData[0] * waveAmp);
    for(var i=1; i < canvas.width; i++){
        context.lineTo(i, waveAmp - fbData[i*stepInc] * waveAmp);
    }
    context.strokeStyle = "#ffff";
    context.stroke();
}
audio.play();
}
</script>
```

This example delivers a rudimentary `canvas` implementation that visualizes audio with waveforms (see [Figure 4-3](#)).

In this solution, we combine what you've already learned about `canvas` in [Chapter 4](#) with some methods from the Mozilla Audio Data API. Let's break it down piece-by-piece, starting with the core `audio` element, `canvas`, and a button to trigger the visualization:

```
<audio src="audio.ogg"></audio>
<canvas width="512" height="100"></canvas>
<button title="Generate Waveform" onclick="genWave()>Generate Waveform</button>
```



For brevity's sake, I'm using the `src` attribute for `audio` in this example, but this would also work with multiple `source` elements.

Next, add a background color via CSS to indicate a simple presentation for the `canvas`:

```
<style>
    canvas {background: #000;}
</style>
```



Note that the `width` and `height` values in `canvas` are DOM attributes, not style attributes. As such, you need to specify them in the markup, not the CSS, so that the browser knows the dimensions of its drawing space. See [Chapter 9](#) for more on `canvas`.

And now for the JavaScript. First, set up an overall function to generate the wave:

```
<script>
    function genWave(){
```

Inside that function, get both the `audio` and `canvas` elements:

```
    var audio = document.getElementsByTagName("audio")[0];
    var canvas = document.getElementsByTagName("canvas")[0];
```

Then set up `canvas` with its drawing context (see <http://diveintohtml5.org/canvas.html#shapes>):

```
    var context = canvas.getContext('2d');
```

Next, add an event listener to gather data about the audio file using methods from the Mozilla Audio Data API ([https://developer.mozilla.org/en/Introducing\\_the\\_Audio\\_API\\_Extension#section\\_2](https://developer.mozilla.org/en/Introducing_the_Audio_API_Extension#section_2)):

```
    audio.addEventListener("MozAudioAvailable", buildWave, false);
```

Then, include a private function to build the `canvas` wave drawing, and get the number of channels and `frameBufferLength`:

```
function buildWave (event){
    var channels = audio.mozChannels;
    var frameBufferLength = audio.mozFrameBufferLength;
```



Note that you need to divide `frameBufferLength` by `channels` because `frameBuffer` contains an array of audio samples that are not separated by channels, but are all delivered together.

Get `frameBuffer` data:

```
var fbData = event.frameBuffer;
```

Set step increment:

```
var stepInc = (frameBufferLength / channels) / canvas.width;
```

And set wave amplitude:

```
var waveAmp = canvas.height / 2;
```

Next, reset `canvas` so the strokes don't build on top of each other:

```
canvas.width = canvas.width;
```

Finally, build the stroke and set stroke properties:

```
context.beginPath();
context.moveTo(0, waveAmp - fbData[0] * waveAmp);
for(var i=1; i < canvas.width; i++){
    context.lineTo(i, waveAmp - fbData[i*stepInc] * waveAmp);
}
context.strokeStyle = "#ffff";
```

Add the stroke to `canvas`:

```
context.stroke();
}
```

And play the audio:

```
audio.play();
}
</script>
```

## Discussion

Just as generating real time audio with JavaScript (“[Generating audio Using JavaScript](#)” on page 92) is limited to Firefox 4+, so is this method of `audio` visualization with `canvas`. This is because only the Mozilla Audio Data API allows you to access the key audio data (in this example, `frameBuffer`) necessary to create the `canvas` drawing. Further, this method of audio visualization must run on a web server, and requires that the audio file reside on that *same server* due to Firefox security measures ([https://wiki.mozilla.org/Audio\\_Data\\_API#Security](https://wiki.mozilla.org/Audio_Data_API#Security)).

## See Also

Check out a far more sophisticated and interactive use of `audio` and `canvas` from 9elements: <http://9elements.com/io/projects/html5/canvas/>.

## Sample Design: Custom Audio Player

In this sample design, we’ll extend the concepts of “[Manipulating the Audio Stream](#)” on page 90 to create a custom audio player (see Figure 4-4), rather than relying on the default `controls` attribute.

## Define audio and player structure

First the markup for our HTML5 audio and player controls:

```
<div id="player">
  <audio src="media/audio.mp3"></audio>

  <div class="playerControls">
    <button id="audioPlay" title="Play" onclick="playPause();">▶</button>
    <button id="audioPause" class="hidden" title="Pause" onclick="playPause();">⏸</button>
  </div>
</div>
```

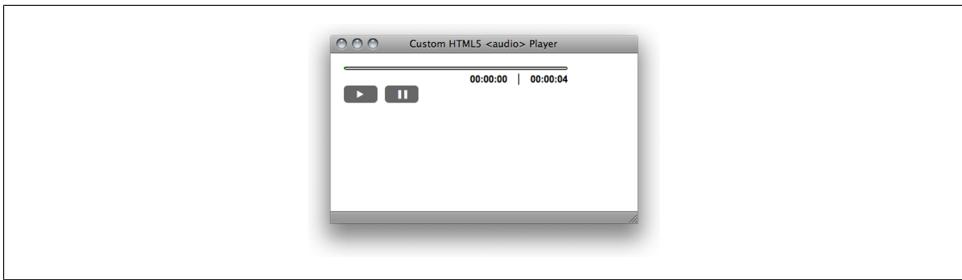


Figure 4-4. The final design for the custom audio player as displayed in Safari 5.

```
<button id="audioStop" title="Stop" onclick="playStop();">&#x25a0;</button>

<div id="audioSeek">
    <div id="audioLoaded"></div>
</div>

<ul id="audioTimes">
    <li id="audioElapsed">00:00:00</li>
    <li id="audioDuration">00:00:00</li>
</ul>
</div>
</div>
```

For the purposes of simplicity, this example includes a play/pause toggle, stop and a progress bar.



The choice of the `button` element for the player controls is simply a semantic and accessibility preference, not a requirement.

## JavaScript API

Next, we turn to the powerful DOM API to deliver functionality to the player markup.



For a more usable, accessible experience, you can also use detection (see <http://diveintohtml5.org/everything.html>.) for HTML5 audio. Then, only if it is supported, will the player markup and `audio` element be inserted. In turn, browsers that don't support HTML5 audio won't see a player they can't use. Modernizr (see <http://modernizr.com>) can also aid in this detection.

First, declare the `audio` element and player controls, making sure the `script` appears after the `audio` element in the source:

```
<script>
    audio = document.getElementsByTagName("audio")[0];
    audioDuration = document.getElementById("audioDuration");
```

```
audioElapsed = document.getElementById("audioElapsed");
audioPlay = document.getElementById("audioPlay");
audioPause = document.getElementById("audioPause");
audioStop = document.getElementById("audioStop");
audioLoaded = document.getElementById("audioLoaded");
```

Then determine eventful information about the audio file:

```
audio.addEventListener("loadedmetadata", setDuration, false);
audio.addEventListener("timeupdate", setElapsed, false);
```

Next, define the functions driving the progress bar:

```
function setDuration(event) {
    audioDuration.innerHTML = timeFormatter(audio.duration);
}

function setElapsed(event) {
    audioElapsed.innerHTML = timeFormatter(audio.currentTime);
    amountLoaded = (audio.currentTime/audio.duration)*100;
    audioLoaded.style.width = amountLoaded + 'px';
}
```

And the function to toggle play and pause:

```
function playPause() {
    if (audio.paused){
        audio.play();
        audioPlay.className = 'hidden';
        audioPause.className = '';
    } else {
        audio.pause();
        audioPlay.className = '';
        audioPause.className = 'hidden';
    }
}
```

Then the function for the stop, which is based on [“Manipulating the Audio Stream” on page 90](#):

```
function playStop() {
    audio.pause();
    audio.currentTime=0;
    audioPlay.className = '';
    audioPause.className = 'hidden';
}
```

And the function to format the time for the progress bar:

```
function timeFormatter(seconds){
    function zeroPad(str) {
        if (str.length > 2) return str;
        for (i=0; i<(2-str.length); i++) {
            str = "0" + str;
        }
        return str;
    }
    var minute = 60,
```

```

        hour = minute * 60,
        hStr = "",
        mStr = "",
        sStr = "";

    var h = Math.floor(seconds / hour);
    hStr = zeroPad(String(h));

    var m = Math.floor((seconds - (h * hour)) / minute);
    mStr = zeroPad(String(m));

    var s = Math.floor((seconds - (h * hour)) - (m * minute));
    sStr = zeroPad(String(s));

    return (hStr + ":" + mStr + ":" + sStr);
}
</script>

```

## CSS for Style

Finally, we style our player so it doesn't look quite so plain (see [Figure 4-5](#)). First, styles for the dimensions of the player and how the buttons should appear:

```

#player {
    height: 50px;
    padding: 10px;
    position: relative;
    width: 300px;
}

button {
    background: #666;
    border: 1px;
    -moz-border-radius: 5px;
    border-radius: 5px;
    bottom: 10px;
    color: #fff;
    padding: 5px;
    position: absolute;
    width: 45px;
}

#audioStop {
    font-size: 22px;
    left: 65px;
    line-height: 11px;
}

```

Then, styles that help with the play/pause toggle:

```

#audioPlay.hidden,
#audioPause.hidden { display: none; }

#audioSeek {
    background: #ccc;

```

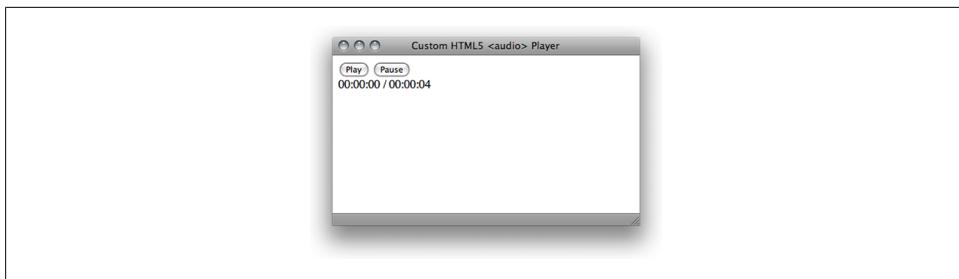


Figure 4-5. Unstyled audio player as viewed in Safari 5.

```
border: 1px solid #000;  
-moz-border-radius: 10px;  
border-radius: 10px;  
display:block;  
height:2px;  
}
```

Next, styles for the green progress bar:

```
#audioLoaded {  
background: #0c0;  
border: 1px solid #0c0;  
-moz-border-radius: 10px;  
border-radius: 10px;  
display:block;  
height:1px;  
}
```

And, finally, styles for the time counters:

```
#audioTimes {  
float:right;  
list-style:none;  
margin: 5px 0 0;  
}  
  
#audioTimes li {  
font:bold 13px Arial, Helvetica sans-serif;  
float: left;  
}  
  
#audioTimes li:first-child {  
border-right: 1px solid #000;  
margin-right: 15px;  
padding-right: 15px;  
}
```

## See Also

Not into rolling your own? There are a few pre-built solutions you can consider for customized player controls, including playlist features:

- jPlayer jQuery plugin: <http://www.jplayer.org>
- MooTools HTML5 Audio Player: <http://simulacre.org/mootools-html5-audio-player>

And be sure to check out the “Creating Your Own Accessible HTML5 Media Player” tutorial: <http://terrillthompson.blogspot.com/2010/08/creating-your-own-accessible-html5.html>.



# Native Video

*Emily Lewis*

## Introduction

HTML5's new embedded content elements offers designers and developers more options for including media in our sites.

Similar in nature to `audio`, the `video` element shares many of the same attributes, have a similar syntax and can be styled and manipulated with CSS and JavaScript. And just like `audio`, `video` has some implementation challenges.

## Adding HTML5 Video

### Problem

You want to play native video on your web page.

### Solution

Use the `video` element with the addition of a `src` attribute that references the location of your video file:

```
<video src="video.ogv"></video>
```

To display default video player controls (see [Figure 5-1](#)) add the Boolean `controls` attribute:

```
<video src="video.ogv" controls></video>
```



Native player controls look different in different browsers. Style your own controls with JavaScript and CSS (see Sample Design 5.5).

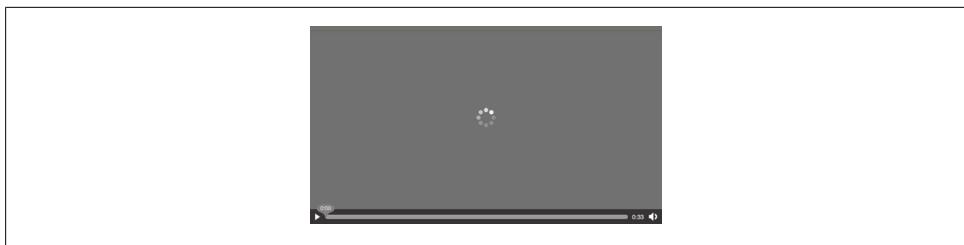


Figure 5-1. Default video player controls in Firefox 4

## Preloading

The `preload` attribute allows you to *suggest* to the browser whether and how it should download the video.

```
<video src="video.ogv" controls preload></controls>
```

You can skip the attribute and let the browser decide or give browsers a “hint” with specific values:

- `preload="auto"` or, simply, `preload`
- `preload="metadata"`
- `preload="none"`

## Fallback Content

You should also make it standard practice to include *fallback content* with `video`:

```
<video src="video.ogv" controls>
  Your device does not support HTML5 video. <a href="video.ogg">Download the Learning to Love HTML5 in</a>
</video>
```



Note that fallback content is not the same as accessibility or providing accessible content.

Fallback content is content that displays on browsers that don't support `video` and does two things: First, it informs the user their browser doesn't support HTML5 video and, secondly, provides a link to download the video.

For a good overview of the state of HTML5 video accessibility: <http://john.foliot.ca/accessibility-and-html5-today/>

Along with different video formats, Flash video can be inserted as a fallback alternative.

In fact, you can nest fallback content for lack of support for both the `object` and `video` elements:

```
<video src="video.ogv" controls>
  <object type="application/x-shockwave-flash"
  data="player.swf?file=video.mp4">
```

```
<param name="movie" value="player.swf?file=video.mp4">
<a href="video.mp4">Download the Learning to Love HTML5
introductory video</a>
</object>
</video>
```

## Discussion

Unfortunately, `video` is not as straightforward to implement as it would seem, because not all browsers support the same set of video file formats.

### Multiple Video Codecs

Like with audio, the HTML5 specification doesn't specify which video codecs should be supported.

Instead, the browser makers decide which format to support (see [Table 5-1](#)), which is fine.

However, getting browser vendors to agree on any one thing is nearly impossible. Getting them to agree on which video formats—much less a single video format—to support is going to be next to impossible.



While the `blink` element is almost universally disliked, it's still supported in browsers. Go figure.

To workaround this situation, video needs to be encoded and published in multiple formats in order to display across the broadest range of browsers.

*Table 5-1. Current browser support for video formats*

Browser	H.264 (.mp4)	Ogg Theora (.ogv)	VP8 (.webm)
Chrome 6+	R	Y	Y
Firefox 3.6+		Y	Y
IE9+	Y		D
Opera 10.5+		Y	Y
Safari 5+	Y		

As you can see from [Table 5-1](#), if you want to reach all of the latest browsers you need to include *at least* `.mp4` and `.ogv` formats.

*.mp4*

The container format for the proprietary H.264 codec that encodes video for a full range of devices, including high definition.

*.ogv*

The free, open source container format for the open source Theora codec. Results in lower quality than H.264.

*.webm*

Another open source container format, which is used by the new, royalty-free VP8 codec from Google.



Google is pulling support for H.264 in Chrome (see <http://blog.chromium.org/2011/01/html-video-codec-support-in-chrome.html>) while Microsoft's IE9 supports VP8 with the installation of a decoder (see <http://windowsteamblog.com/windows/b/bloggingwindows/archive/2010/05/19/another-follow-up-on-html5-video-in-ie9.aspx>).

Why is there a messy situation with video codecs? A large factor is intellectual property and licensing fees. To use certain formats (and, therefore, codecs) natively, browser makers are subject to the intellectual property rights of the codecs and formats.

For H.264, Apple and Microsoft have paid the licensing fees to allow that video codec play natively in their respective browsers.

Vendors that produce Firefox and Opera browsers, meanwhile, opt to support free, open source formats.



For a more in-depth explanation of why there are so many codecs and formats for video, Adobe TV has a great introductory video from Stephanie Sullivan Rewis on HTML5 video: <http://tv.adobe.com/watch/adc-presents/videoandhtml5part2gettingstarted/> You will need Flash installed on your Internet-enabled device in order to see it, though.

## Browser Support

Aside from the challenges of dealing with multiple codecs and format containers, `video` has full support in all of the latest browsers. However, `video` is not supported in Internet Explorer 8 and below. For these earlier versions, you'll need to rely on fallback content.

## See Also

For open source videos for developing and experimenting with HTML5 video support, search the Internet Archive (see <http://www.archive.org/details/movies>).

# Ensuring Multi-Browser Video Support

## Problem

You want to make sure your native video plays on the broadest range of browsers possible.

## Solution

Use the `source` child element of `video` to specify each of your video formats:

```
<video controls>
  <source src="video.mp4" />
  <source src="video.ogv" />
  Your device does not support HTML5 video.
</video>
```



Note that you must remove the `src` attribute and value from `video` element as seen in “[Adding HTML5 Video](#)” on page 103.

As we saw in [Table 5-1](#), using `.mp4` and `.ogv` covers all browsers that support HTML5. But order matters, too.

In terms of order, list your source formats from most to least desirable. Browsers will play the first format they recognize. Note, though, in iOS 3, there is a bug that won’t recognize anything but the first `source` element.

If you are targeting those users, **put your `.mp4` reference first**. Otherwise, the free iOS 4 upgrade resolves this issue.



The Video for Everybody site provides comprehensive details about bugs and device nuances with HTML5 video: [http://camendesign.com/code/video\\_for\\_everybody/](http://camendesign.com/code/video_for_everybody/)

## Discussion

Beyond specifying the audio files themselves, it is good practice to also specify the *MIME type* for your video files.:

```
<source src="video.mp4" type="video/mp4" />
<source src="video.ogv" type="video/ogg" />
```



Firefox does not play Ogg video if the MIME type is wrong.

Since file formats are simply containers for different codecs, specify the compression used:

```
<source src="video.ogv" type="video/ogg; codecs='theora'">
```

The MIME type speeds up rendering of the video since it indicates what kind of content the browser is utilizing without the browser having to download a portion to make its own determination.

Here are some examples of MIME types with codecs:

```
type="video/ogg; codecs='theora, vorbis'"  
type="video/mp4; codecs='avc1.42E01E'"  
type="video/webm; codecs='vp8, vorbis'"
```

Unfortunately, even if you declare your MIME types with the proper codec in your HTML, there can also be challenges related to the MIME types *supported by your server*. If your server isn't configured to support the MIME types your video uses, there will be playback issues.

You can, however, configure your server to support video MIME types. Information about Ogg media from the Mozilla Developer Center ([https://developer.mozilla.org/en/Configuring\\_servers\\_for\\_Ogg\\_media](https://developer.mozilla.org/en/Configuring_servers_for_Ogg_media)) can be equally applied to .webm and .mp4.

## See Also

If you have your own video, but want to convert it to other formats, check out these tools:

- Miro VideoConverter: <http://www.mirovideoconverter.com/>
- WebM Tools: <http://www.webmproject.org/tools/>
- MPEG StreamClip: <http://www.squared5.com/>
- TinyOgg: <http://tinyogg.com/>
- OggConvert: <http://oggconvert.tristanb.net/>

## Setting Video Dimensions

### Problem

You want to specify the width and height of your video player:

## Solution

Add the `width` and `height` attributes, and their corresponding values, to `video`:

```
<video controls width="640" height="360">
  <source src="video.mp4" type="video/mp4" />
  <source src="video.ogv" type="video/ogg" />
  Your device does not support HTML5 video.
</video>
```

## Discussion

Browsers render the video player according to the dimensions you assign, not the resolution of your actual video.

Using different dimensions might lead to a loss in quality by expanding a video beyond its native resolution; the same goes for scaling down a large video simply to fit into a small space.

So, when possible, use the *same* dimension values for the `video` element as for the video file itself, and don't resize your video with `width` and `height`.

Technically speaking, the `width` and `height` of a `video` element does not need to be set as browsers default to inheriting dimensions of the video file itself.

The drawback to this approach is that if the dimensions are not set, browsers won't know what space to reserve for your video and may have to redraw your page after it downloads the video data.

The `width` and `height` values need to be set in CSS pixels as integers and not as percentages or other values.

Adding dimension values helps browsers more efficiently render your pages, which usually results in a better user experience too.

Since you probably don't want to use `width` and `height` to resize your video different than its native dimensions, you can instead use encoding software to specify the resolution.

Mark Pilgrim's "Dive Into HTML5" (see <http://diveintohtml5.org/video.html>) provides very detailed instructions about using many of the encoding tools available.

## See Also

CSS Pixel at <http://www.emdpi.com/csspixel.html>.



Figure 5-2. Since Firefox doesn't support .mp4 files, the browser displays a dark grey box if there is no poster image specified.

## Displaying a Placeholder Image Before Video Plays

### Problem

You want to display a still-frame, or poster image, before the user starts the video.

### Solution

Add the `poster` attribute with the placeholder image file path as the value:

```
<video controls width="640" height="360" poster="video_still.png">
  <source src="video.mp4" type="video/mp4" />
  <source src="video.ogv" type="video/ogg" />
  Your device does not support HTML5 video.
</video>
```

### Discussion

Poster images can be a nice user enhancement, especially when the video doesn't load or can't be displayed.

Consider a single-source mp4 video viewed in Firefox as shown in [Figure 5-2](#):

Unfortunately, different browsers handle poster images differently.

- Firefox stretches the image to fill the dimensions (see “[Setting Video Dimensions](#)” on page 108) of the player.
- Chrome keeps the image its original size.
- Safari displays the poster image until the video data is loaded, at which point it displays the first frame from the video. If the poster image is a different size from the video, the video is resized to match the aspect ratio of poster image (see [Figure 5-3](#)).



Figure 5-3. Safari 5 resizes the video to match the aspect ratio of the poster image, making it important to ensure your images are sized correctly.

## See Also

John Foliot points out the lack of accessibility of the `poster` attribute, so keep this limitation in mind when using `poster` at <http://john.foliot.ca/the-current-problem-with-the-poster-attribute-of-the-video-element/>.

# Making Video Loop

## Problem

You want your video playback to loop automatically.

## Solution

Add the `loop` Boolean attribute to `video`:

```
<video controls width="640" height="360" loop>
  <source src="video.mp4" type="video/mp4" />
  <source src="video.ogv" type="video/ogg" />
  Your device does not support HTML5 video.
</video>
```

## Discussion

As of this writing, Firefox does not support `loop` unless the user has the Media Loop add-on (<https://addons.mozilla.org/en-US/firefox/addon/media-loop-45730/>) installed. All other browsers will loop natively.

That said, use `loop` *thoughtfully*. Consider how your users experience a video that loops and whether that experience is appropriate for your particular video and pleasant for your audience.



Figure 5-4. When selecting which size video you want to embed, YouTube offers static illustrations that lack context.

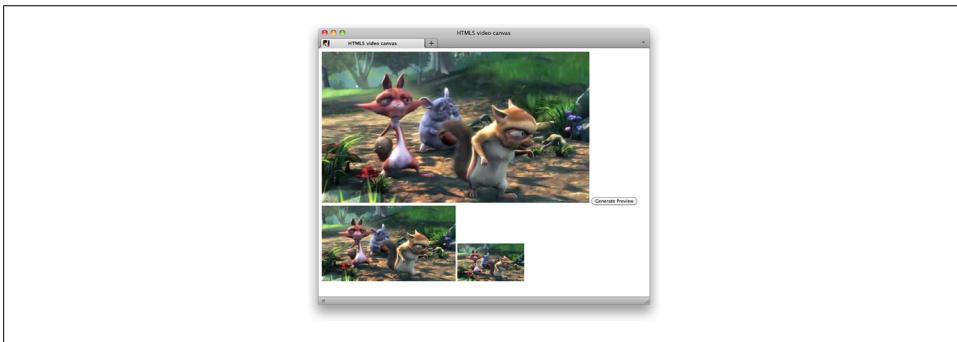


Figure 5-5. Using scaling, different sizes of the single video instance are drawn on the canvas in Firefox.

### Autoplay

Another `video` attribute you should judiciously consider before implementing is the Boolean `autoplay`. Just as with `audio`, `autoplay` starts playing the video as soon as the page loads. And, just as with `audio`, it can be an extremely unpleasant user experience.

## See Also

Not all Firefox users will know about the Media Loop add-on, much less have it installed. If you desperately need looping to work across all browsers, you can consider a JavaScript-based solution: <http://forestmist.org/2010/04/html5-audio-loops/>.

## Sample Design: Manipulating Video With canvas

Have you ever wanted to embed a video from YouTube, but wanted a better preview of how your video might appear than their default selection key (see Figure 5-4)?

In this Sample Design, we use `canvas` (see Chapter 9) to create a better and more contextual preview of what video may look like at different sizes (see Figure 5-5).

## Add video and canvas

To start, re-use the markup used in this chapter for `video`, and add a `button` to trigger the drawing, as well as two `canvas` elements, one for a medium preview and one for a small.

To each element, assign a unique `id`:

```
<video id="origVideo" width="640" height="360">
  <source src="video.mp4" type="video/mp4" />
  <source src="video.ogv" type="video/ogg" />
  Your device does not support HTML5 video.
</video>

<button title="Generate Preview" onclick="generatePreview();">Generate Preview</button>

<canvas id="previewMed"></canvas>
<canvas id="previewSm"></canvas>
```

## Generate Preview

Next, create a function to generate the preview and set the JavaScript variables for our `video` and `canvas` elements:

```
<script>
  function generatePreview(){
    var video = document.getElementById('origVideo');
    var canvas1 = document.getElementById('previewMed');
    var context1 = canvas1.getContext('2d');
    var canvas2 = document.getElementById('previewSm');
    var context2 = canvas2.getContext('2d');
```

Note the variables to specify the 2D context for each `canvas` drawing state are also declared.

## Set Preview Dimensions

Next, define the dimensions for each of the `canvas` drawings in the function:

```
  canvas1.width = 320;
  canvas1.height = 180;
  canvas2.width = 160;
  canvas2.height = 90;
```

## Add an Event Listener

Then add an event listener to trigger the `canvas` drawing upon video play:

```
  video.addEventListener('play', function(){
    drawVideo(this,context1,context2);
  },false);
```

## And close out the function:

```
    video.play();  
}
```

## Draw Previews

Lastly, add the function that draws each of the `canvas` previews:

```
function drawVideo(video,canvas1,canvas2) {  
    if(video.paused || video.ended) return false;  
    canvas1.drawImage(video,0,0,320,180);  
    canvas2.drawImage(video,0,0,160,90);  
    setTimeout(drawVideos,25,video,canvas1,canvas2);  
}  
</script>
```

This function first checks to see if the video is playing:

```
if(video.paused || video.ended) return false;
```

If so, use `drawImage` with scaling to draw a `canvas` image that is half the size of the original video:

```
    canvas1.drawImage(video,0,0,320,180);
```

And a second `canvas` that is half the size of `previewMed`:

```
    canvas2.drawImage(video,0,0,160,90);
```

The scaling parameters in these examples are:

```
object.drawImage(source,x,y,width,height);
```

Where `x` and `y` represent the top left corner of the image on the target canvas, and `width` and `height` are the image's size on the target `canvas`.

Finally, tell `drawPreviews` to call itself every 25 milliseconds, which roughly equals 40 frames per second (1000ms/40fps = 25):

```
    setTimeout(drawVideos,25,video,canvas1,canvas2);
```

## The Final Product

The complete markup and script for this example:

```
<video id="origVideo" width="640" height="360">  
    <source src="video.mp4" type="video/mp4" />  
    <source src="video.ogv" type="video/ogg" />  
    Your device does not support HTML5 video.  
</video>  
  
<button title="Generate Preview" onclick="generatePreview();">Generate Preview</button>  
  
<canvas id="previewMed"></canvas>  
<canvas id="previewSm"></canvas>
```

```
<script>
    function generatePreview(){
        var video = document.getElementById('origVideo');
        var canvas1 = document.getElementById('previewMed');
        var context1 = canvas1.getContext('2d');
        var canvas2 = document.getElementById('prevewsSm');
        var context2 = canvas2.getContext('2d');

        canvas1.width = 320;
        canvas1.height = 180;
        canvas2.width = 160;
        canvas2.height = 90;

        video.addEventListener('play', function(){
            drawVideo(this,context1,context2);
        },false);

        video.play();
    }

    function drawVideo(video,canvas1,canvas2) {
        if(video.paused || video.ended)    return false;
        canvas1.drawImage(video,0,0,320,180);
        canvas2.drawImage(video,0,0,160,90);
        setTimeout(drawVideos,25,video,canvas1,canvas2);
    }
</script>
```

## See Also

HTML5 Doctor offers demos and detailed descriptions of other ways to use `canvas` and `video` together at <http://html5doctor.com/video-canvas-magic/>.



# Microdata and Custom Data

*Kimberly Blessing*

## Introduction

One of the primary benefits of web standards, promoted for over 10 years by standards evangelists, was that more semantic markup would provide greater context and meaning to content.

By the mid 2000s, web standards were catching on, but the “standardistas” recognized that semantic markup alone was not enough to convey all meaning related to content – for example, that some content is personal data or that links may represent relationships.

First came XFN (XHTML Friends Network) to solve for this problem (see <http://gmpg.org/xfn/>), and then Microformats (see <http://microformats.org/>).

Both of these solutions relied on the `class` and `rel` attributes—both valid (X)HTML—but, because those attributes had more appropriate uses, some web professionals felt that using them to convey additional semantics was somewhat of a hack. At the same time, the W3C XHTML 2 Working Group created the RDFa specification, based on the Resource Description Framework, to enable reuse of existing XHTML attributes—and the addition of some new ones—to support structured machine-readable data.

Microformats, in particular, caught on quickly with web professionals.

Web builders started using them to markup personal information, resumes, event data, and even cooking recipes. Search engines picked up on this and began parsing the additional data found in Microformats and RDFa to improve search results.

With HTML 5, the web community has a renewed focus on strictly adhering to the specification. Rather than continue to extend—some would say abuse—the `class` and `rel` attributes, HTML 5 (at least via the WHATWG spec) introduces *microdata*, which gives us a new syntax for marking up these additional structured semantics.

In addition, HTML 5 allows for *custom data attributes*, which further give web professionals a standards-compliant way for embedding additional data in their markup.

The markup aspects of these features work in browsers today, but the associated DOM APIs to interact with them are not yet (microdata) or widely (custom data) supported by user agents.

Given that it is possible to write JavaScript to interact with the additional data, there's little reason *not* to use them.

## When to use microdata versus custom data

Similar to microformats and RDFa, microdata is used to mark up structured data. It introduces new attributes that can be applied to any element in order to identify scoped name-value pairs. Like microformats, shared vocabularies are emerging to standardize how data is marked up, so microdata can be used to share data across web sites and applications.

Custom data attributes are just that: *custom*.

You, the programmer, create attributes using the `data-` prefix and assign them a value. This name-value pair is related to the displayed content, but is not itself displayed. Because you define the attributes according to the needs of your web site or application, these are not to be used to exchange data with another site, nor do public search engines consume them.



Should you use microdata or RDFa for your structured data? Ongoing W3C discussions about whether or not two overlapping standards should exist have some concerned about the future of these specifications. Google, Microsoft, and Yahoo, meanwhile, are promoting microdata, having teamed up to create [Schema.org](http://schema.org), a shared vocabulary of data structures that allows their search engines to extract more meaning from your data.

For an excellent comparison of microdata, RDFa, and microformats, read Manu Sporny's detailed analysis at <http://manu.sporny.org/2011/uber-comparison-rdfa-md-uf/>.

## Adding Microdata to Markup

### Problem

You want to add microdata to convey additional meaning or semantics about your content so that machine-parsing tools can access this information.

## Solution

Use the `itemscope` and `itemprop` attributes, along with descriptive property names, to label your content.

```
<p itemscope>
  <span itemprop="inventor">Tim Berners-Lee</span> created the <span itemprop="invention">World Wide Web</span>
```

## Discussion

The `itemscope` attribute is used to identify the scope of the microdata item—an item being a set of name-value pairs. The `itemprop` attribute values define the property names, and their associated values, in this case, are the contents of the `span` tags. Thus, this example yields the following name value pairs:

- Inventor: Tim Berners-Lee
- Invention: World Wide Web

This is a very basic example. In the next section, we'll look at an example that implements a standardized vocabulary.

## See Also

The `itemprop` attribute in the HTML5 specification at <http://www.w3.org/TR/html5/microdata.html#names:-the-itemprop-attribute>.

# Using Microdata and Schema.org

## Problem

You want to convey additional meaning about your content—for example, that the content identifies a person—so that popular search engines can extrapolate this data.

## Solution

In addition to using the `itemscope` and `itemprop` attributes, specify an `itemtype` and apply the appropriate property names from the Schema.org vocabulary:

```
<section itemscope itemtype="http://schema.org/Person">
  <h1 itemprop="name">Tim Berners-Lee</h1>
  
  <p>
    <span itemprop="jobTitle">Director</span>,
    <span itemprop="affiliation" itemscope itemtype="http://schema.org/Organization" itemprop="name">
      <p itemprop="address" itemscope itemtype="http://schema.org/PostalAddress">
        <span itemprop="addressLocality">Cambridge</span>,
    
```

```

Extracted rich snippet data from the page

Item
  Type: http://schema.org/person
  name = Tim Berners-Lee
  image = http://www.w3.org/Press/Stock/Berners-Lee/2001-europeaum-eighth.jpg
  jobtitle = Director
  affiliation = /item[1]
  address = /item[2]
  url = http://www.w3.org/People/Berners-Lee/

Item 1
  Type: http://schema.org/organization
  name = World Wide Web Consortium

Item 2
  Type: http://schema.org/postaladdress
  addresslocality = Cambridge
  addressregion = MA

```

Figure 6-1. Google Rich Snippets Testing Tool results.

```

<span itemprop="addressRegion">MA</span>
</p>
<a itemprop="url" href="http://www.w3.org/People/Berners-Lee/">Web site at W3C</a>
</section>

```

## Discussion

The start of this microdata item is again indicated by the use of `itemscope` on the `section` element, but also added to this element is the `itemtype` attribute. Use `item` type with a URL in order to identify the item data type. In this case, we're using the Schema.org structure to identify a person.

Just as with the previous section, the `itemprop` attribute is applied with property names to give meaning to the content in the markup. By looking at the properties and pairing them with the content, we know that “Tim Berners-Lee” is a person’s name and that his job title is “Director.”

The use of `itemprop` for both the image and URL properties works a bit differently—the corresponding values in these cases are the `src` and `href` attribute values, respectively. If you’ve worked with microformats in the past, this concept won’t be new to you.

A final special case in this example can be seen with the affiliation and address `itemprop` attributes—here, new items are nested inside of the main item. In both cases, the `itemprop` identifies the property that is directly related to the person item but, within the same tag, also establishes the property as an item itself with the `itemscope` attribute. Going on step further, `itemtype` is also applied to indicate the URL that describes the item data type.

While this might seem a bit complicated at first, realize that it’s not much different than combining multiple microformats (like hCard and hCalendar on a resume) or creating an XML object to represent nested data.

Whether you’ve worked on project like these before or not, there is an easy way to check to see that you’re making progress in applying the Schema.org vocabularies. You can use the Google Rich Snippets Testing Tool (available at <http://www.google.com/webmasters/tools/richsnippets>) to validate that your structured data markup can be parsed as shown in Figure 6-1.



Before Schema.org was created by Google, Microsoft, and Yahoo, Google was promoting Rich Snippets based on its own vocabulary at <http://data-vocabulary.org/>. Google's documentation for Rich Snippets is still live, but every page features a link to Schema.org.

## See Also

- For additional data types that are recognized by search engines, along with sample code, see <http://schema.org/>.
- To learn more about microdata, see HTML5 Doctor's Microdata article (<http://html5doctor.com/microdata/>) and Mark Pilgrim's chapter from Dive Into HTML5 (see <http://diveintohtml5.org/extensibility.html>), which also details Google Rich Snippets.

# Adding Custom Data to Markup

## Problem

You want to attach additional data to your content that is not displayed to the user.

## Solution

Define your own `data-` attributes to name and store the information:

```
<h1>My Volkswagens</h1>
<ul>
    <li data-year="1996" data-color="white" data-engine="VR6">Cabrio</li>
    <li data-year="1993" data-color="purple" data-engine="VR6">Corrado</li>
    <li data-year="2008" data-color="red" data-engine="2.0T">Eos</li>
    <li data-year="2003" data-color="blue" data-engine="W8">Passat</li>
</ul>
```

## Discussion

Since not everyone cares about VWs or cars, and so there's a lot of detail we need not provide—like the year, color, and engine type of each VW.

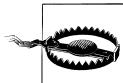
With custom data attributes, extraneous data is included in the markup and it's not requiring my readers to look at it.



Since the data is now stored in the HTML, read the subsequent Recipes in this chapter to learn what else you can do with the data.

In order to store the year, color, and engine type of each car, we created three custom data attributes: `data-year`, `data-color`, and `data-engine`.

As you can see, they all start with `data-` followed by at least one character. The name you define may not include uppercase letters, but it can include hyphens. You could have, for example, defined `data-model-year`, but `data-modelYear` would not be allowed.



If your custom data attributes have additional hyphens in the name, you need to convert them to camel case names when using the dataset API—for example, `data-foo-bar` would be referred to as `dataset.fooBar`. But if using `getAttribute` or `setAttribute`, you still reference it as `data-foo-bar`.

Even though we use the three custom attributes consistently in the example above, we haven't created any special relationships by using them together—for example, you could list another car and only apply a `data-color` attribute.

Or you could go on to list airplanes that you've flown, and reuse the `data-engine` attribute. It's up to you, the programmer, to maintain structure or define the name space you need for your web site or application.

## See Also

More discussion about HTML5 custom data attributes at <http://html5doctor.com/html5-custom-data-attributes/>.

# Accessing Custom Data with JavaScript

## Problem

You want to access the custom data in your page and perform execute some logic based on the data.

## Solution

Start with the same markup as “[Adding Custom Data to Markup](#)” on page 121 but add a paragraph for JavaScript output:

```
<h1>My Volkswagens</h1>
<ul>
  <li data-year="1996" data-color="white" data-engine="VR6">Cabrio</li>
  <li data-year="1993" data-color="purple" data-engine="VR6">Corrado</li>
  <li data-year="2008" data-color="red" data-engine="2.0T">Eos</li>
  <li data-year="2003" data-color="blue" data-engine="W8">Passat</li>
</ul>
<p></p>
```

Access the custom data using the dataset API:

```
<script>
  var cars = document.getElementsByTagName("li");
  var output = "What color are Kimberly's cars? ";

  for (var i=0; i < cars.length; i++) {
    output += cars[i].dataset.color;
    if (i != (cars.length-1)) {
      output += ", "
    }
  }

  document.getElementsByTagName("p")[0].innerHTML = output;
</script>
```

## Discussion

With the introduction of custom data attributes, HTML5 also defines the dataset DOM API. It is a simple and easy way of accessing any custom data associated with any element.

The JavaScript is straightforward: we create an array of all list items (`cars`) and we create a string that is inserted into the paragraph (`output`). As we iterate over the cars array, we use `dataset.color` to access the value of each data-color attribute, and we append it to the output variable. The end result is the phrase “What color are Kimberly's cars? White, purple, red, blue” being added to the paragraph at the end of the list.

Not all browsers yet support the dataset API (see [Table 6-1](#)), but accessing custom data attributes in all browsers is easy. Where dataset is not supported, simply use `getAttribute`.

Here's the for loop using fallback logic and `getAttribute` when necessary:

```
for (i=0; i < cars.length; i++) {
  if (cars[i].dataset) {
    output += cars[i].dataset.color;
  } else {
    output += cars[i].getAttribute("data-color");
  }
  if (i != (cars.length-1)) {
    output += ", "
  }
}
```

*Table 6-1. Dataset API support.*

IE	Firefox	Chrome	Safari	Opera	iOS	Android
-	6+	7+	5.1+	11.1+	-	-

To keep up with dataset API support, check <http://caniuse.com/dataset> regularly.

## See Also

The itemprop attribute in the HTML5 specification at <http://www.w3.org/TR/html5/microdata.html#names:-the-itemprop-attribute>.

# Manipulating Custom Data

## Problem

You want to manipulate existing custom data in your page or add custom data to your page.

## Solution

Let's build on the code from “Accessing Custom Data with JavaScript” on page 122. Use the same markup to start:

```
<h1>My Volkswagens</h1>
<ul>
    <li data-year="1996" data-color="white" data-engine="VR6">Cabrio</li>
    <li data-year="1993" data-color="purple" data-engine="VR6">Corrado</li>
    <li data-year="2008" data-color="red" data-engine="2.0T">Eos</li>
    <li data-year="2003" data-color="blue" data-engine="W8">Passat</li>
</ul>
<p></p>
```

Use the dataset API to modify and create custom data, along with setAttribute for fallback support:

```
<script>
    var cars = document.getElementsByTagName("li");
    for (var i=0; i < cars.length; i++) {
        if (cars[i].dataset) {
            cars[i].dataset.color = "yellow";
            cars[i].dataset.rating = "awesome";
        } else {
            cars[i].setAttribute("data-color", "yellow");
            cars[i].setAttribute("data-rating", "awesome");
        }
    }

    var output = "What color are Kimberly's cars? ";

    for (var i=0; i < cars.length; i++) {
        if (cars[i].dataset) {
            output += cars[i].dataset.color;
        } else {
            output += cars[i].getAttribute("data-color");
        }
        if (i != (cars.length-1)) {
            output += ", "
        }
    }
</script>
```

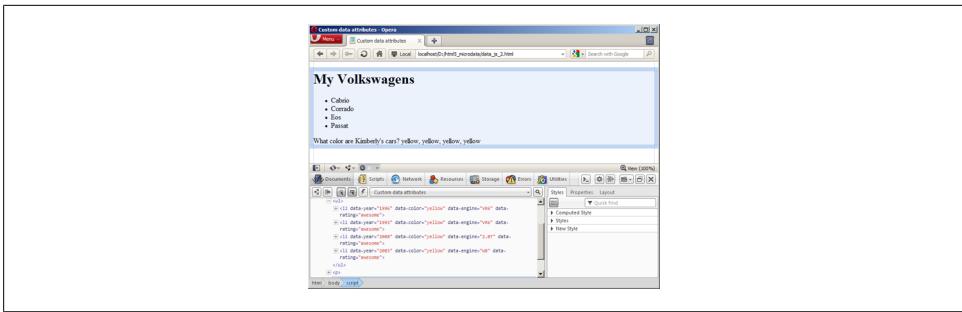


Figure 6-2. Dataset modification in Opera 11.1 with Dragonfly.

```
        }
    }

    document.getElementsByTagName("p")[0].innerHTML = output;
</script>
```

## Discussion

Once you know how to access custom data, manipulating it is pretty easy. If you can use the `dataset` API, just assign the new value to the desired attribute; otherwise fallback to using `setAttribute`. This same method allows you to add new custom data attributes, as well.

In this example, we've decided to repaint all of the cars yellow using JavaScript. Looping through the list items, we access `dataset.color` (or use `setAttribute` to access `data-color`) and assign a new value of "yellow."

Then you can use JavaScript to add a rating for each of the cars. In that same loop,, create `data-rating` by applying a value of "awesome" to `dataset.rating` (or use `setAttribute` to do the same).

If you need to remove a custom data attribute, you can do so by setting its value to `null`. Verify that the DOM is being manipulated by verifying in a tool such as Opera Dragonfly as shown in Figure 6-2.

## See Also

The dataset specification at <http://dev.w3.org/html5/spec/Overview.html#dom-dataset>.

## Example: Creating a Map Application Using Custom Data

### Problem

You want to generate markers on a map using custom data attributes.

## Solution

Store the latitudes and longitudes of the locations you wish to show on the map in separate custom data attributes. Then write JavaScript to access those datasets and render markers on the map:

```
<!DOCTYPE html>
<html>
<head>
<title>Map example</title>
<script type="text/javascript" src="http://maps.google.com/maps/api/js?sensor=false"></script>
<style type="text/css">
#map { height:500px; width:500px; border:1px solid #000; }
</style>
</head>
<body>
<h1>Ice Cream in Philadelphia</h1>
<ul>
<li><a data-lat="39.9530255" data-long="-75.1596066" href="http://www.bassettsicecream.com/">Bassett's</a>
<li><a data-lat="39.949888" data-long="-75.161717" href="http://www.capogirogelato.com/">Capogiro Gelato</a>
<li><a data-lat="39.949556" data-long="-75.1428795" href="http://www.franklinfountain.com/">Franklin Fountain</a>
</ul>

<div id="map"></div>

<script>
var map_options = {
    zoom: 15,
    center: new google.maps.LatLng(39.95, -75.152),
    mapTypeId: google.maps.MapTypeId.HYBRID
};

var map = new google.maps.Map(document.getElementById("map"), map_options);

var locations = document.getElementsByTagName("a");
for (var i=0; i < locations.length; i++) {
    var latitude, longitude;
    if (locations[i].dataset) {
        latitude = locations[i].dataset.lat;
        longitude = locations[i].dataset.long;
    } else {
        latitude = locations[i].getAttribute("data-lat");
        longitude = locations[i].getAttribute("data-long");
    }
    locations[i][i] = new google.maps.Marker({
        position: new google.maps.LatLng(latitude, longitude),
        title: locations[i].innerHTML,
        map: map
    });
}
</script>
</body>
</html>
```

## Discussion

You already know how to define custom data, so the list of anchors containing `data-latitude` and `data-longitude` attributes should be old hat by now.

Creating a Google Map using their APIs is very easy—call their API in the document head, create an element to house the map in the body, then call a script that defines your map options and triggers its rendering.

After the script triggers the drawing of the map, it then accesses the latitude-longitude positions and uses them to render markers on the map.

### Example: The jQuery `data()` method

The jQuery library has provided support for accessing and manipulating custom data since version 1.4.3. This support was updated in jQuery 1.6 to conform to changes in the HTML5 specification; use this version of jQuery if it all possible (see <http://www.webmonkey.com/2011/05/jquery-update-improves-html5-data-tools/>).

Using the jQuery `data()` method is straightforward. Let's return to an earlier example to see how it works.

```
<ul>
  <li data-year="1996" data-color="white" data-engine="VR6">Cabrio</li>
</ul>

<script>
alert($("#li").data("year")); // alerts "1996"
alert($("#li").data("engine")); // alerts "VR6"

// let's repaint the car again
$("#li").data("color", "yellow");

//let's add the rating data
$("#li").data("rating", "awesome");
</script>
```

The jQuery `data` method successfully reads the `data-year` and `data-engine` attributes defined in the markup, but if you access `data-color` via the dataset API or examine the DOM object, you neither see its value turn yellow nor find a `data-rating` attribute as you did in section 6.5.

```
<script>
alert($("#li").data("color")); // alerts "yellow"
alert(document.getElementsByName("li")[0].dataset.color); // alerts "white"
</script>
```

While jQuery reads in the data from the custom data attributes, it does not write this data back to the DOM; instead it stores the data in a JavaScript object. This speeds up applications where a lot of data access or manipulation is performed.

However, if you forget this difference and try to also use the dataset API in your application, you will encounter some unexpected results.

## See Also

A small sampling of applications utilizing microdata:

- PaintbrushJS by Dave Shea: <http://mezzoblue.github.com/PaintbrushJS/demo/index.html>.
- Dynamic Google Analytics Tagging by Jason Karns: <http://jasonkarns.com/blog/2010/03/10/google-analytics-tagging/>.
- SXSW 2010 Parties site by Christopher Schmitt, Kyle Simpson, Stephanie Sullivan, and Zoe Gillenwater: <http://www.sxswcss3.com/>.

# Accessibility

*Anitra Pavka*

## Introduction

Disability is a broad term.

Major categories of disabilities that affect use of the web include visual, hearing, cognitive, and motor. A single category of disability may manifest in many forms. For example, *visual disability* includes, but is not limited to, red-green color blindness. About 7 to 10% of all men have trouble differentiating between red and green colors.

People may have varying degrees of disability and even multiple disabilities. Like a broken wrist or an amputation, disabilities can be temporary or permanent. And permanent disabilities may be from birth or start later in life.

In short, anyone can become disabled.

## The Purpose of Accessibility

Web accessibility is about removing barriers that prevent people from using the web. In fact, one could say accessibility is at the heart of the Web in that its goal is to break-down barriers of communication.

According to the Worldwide Web Consortium (see <http://www.w3.org/standards/webdesign/accessibility>.):

“The Web is fundamentally designed to work for all people, whatever their hardware, software, language, culture, location, or physical or mental ability. When the Web meets this goal, it is accessible to people with a diverse range of hearing, movement, sight, and cognitive ability.”

Web coding and markup is a critical part of removing barriers. But done incorrectly, it can erect more barriers.

The hardware and software used to access web content constitute the rest of the solution. The user agent, such as a browser, and any assistive technology, such as a screen

reader that reads aloud web content, must be able to accurately interpret and present to users the web content or functionality that you coded.

## Accessibility Guidelines

Fortunately, there are published guidelines to provide direction to web designers and developers. If you work on government or publicly funded web sites, you may implement local or federal guidelines such as U.S. Section 508.

Or you may be familiar with phrases like the W3C Web Accessibility Initiative (WAI) or W3C Web Content Accessibility Guidelines (WCAG). The W3C WAI updated the original WCAG. WCAG 2.0 became a W3C recommendation in December 2008, nine years after the first version. These guidelines provide an international set of recommendations on how to make web content more accessible and usable to people with a variety of disabilities.

The WCAG 2.0 uses the acronym POUR to summarize the four principles of web accessibility. POUR stands for Perceivable, Operable, Understandable, and Robust:

### *Perceivable*

Means available to the senses, usually sight or hearing. That means you've done things like provide text alternatives for images, provide captions for audio and video, and include sufficient contrast between the text and the background.

### *Operable*

Ensures that people can use or interact with the web site, including navigation, content, forms, and dynamic controls.

### *Understandable*

Means that text is legible and the site behaves in consistent, predictable ways.

### *Robust*

Defines the page's markup and coding as working in a variety of user agents and assistive technologies.

The W3C WAI also authored WAI-ARIA 1.0 (Accessible Rich Internet Applications). ARIA provides a way to add semantic meaning to Ajax-like, dynamic web content and custom widgets by defining a set of roles and the states and properties of those roles.

In other words, ARIA allows you to programmatically communicate to assistive technology what is displayed to sighted users as the page changes in response to user actions, rather than just what is present in the original page markup.

This is increasingly important because as of Jan 2010, SecuritySpace Technology Penetration Report found that over 64% of web sites included JavaScript (see [http://www.securityspace.com/s\\_survey/data/man.200912/techpen.html](http://www.securityspace.com/s_survey/data/man.200912/techpen.html)).

The work of ARIA specification is still being done and while support is fairly robust and always improving, there are bugs and incomplete support in user agents to contend.

The good thing is that *implementing* ARIA doesn't have to be hard. It's definitely not harder than building cross-browser, custom JavaScript widgets.

And you're already doing that, right?

## Writing Appropriate ALT Text Descriptions

### Problem

You want to add a text alternative for an image.

### Solution

Add the text alternative programmatically using the `alt` attribute of the image.

If an image deserves a text alternative that can be summed up in one to two sentences or about 75 words or less, then set that text as the value of the `alt` attribute.

How do you know how well the alternative text works? A good rule of thumb is “if you can replace every image on the page with its text alternative, the page conveys the same meaning as when the images are displayed.”

```

```

If the image is complex like a chart or diagram and cannot be simply summarized, include the additional information adjacent to the image or link the image to a longer, more detailed text alternative.



If providing additional information beyond an `alt` attribute, ensure that the text is updated whenever changes are made to the associated image.

```
<a href="diagram_desc.html"></a>
```

### Multiple Images

If you need to reference multiple text alternative sources for an image to make sense and all of that content is on the same web page, use the ARIA `aria-labelledby` or `aria-describedby` attributes to reference text alternatives as these ARIA attributes can accept multiple references.

In this example, the `aria-describedby` attributes in the `img` element reference its associated values to `id` attributes in the descriptive `h1` and `p` elements:

```
<h1 id="johnny1">Johnny throwing cake at his Mom while Dad ducks behind her</h1>
<p id="johnny2">Johnny's poor Mom is smeared with cake. Well, that shirt is ruined!</p>
```

```
...  

```

Until `figure` and `figcaption` elements are better supported by user agents and assistive technology, use the `aria-labelledby` attribute to associate an image enclosed in the `figure` element with its caption.

Add the `aria-labelledby` attribute to the `img` element and add its associated value to an `id` attribute of the `figcaption` element:

```
<figure>  
    
  <figcaption id="figcaption123">  
    Opening ceremony for the new library building at the state university.  
  </figcaption>  
</figure>
```

## Discussion

A text alternative for a non-text element such as an image is not necessarily a *description*.

Instead, a text alternative should strive to present the same purpose and information, serving as a replacement for the non-text element.

Providing a text alternative for non-text elements is required to comply with WCAG 2.0. However, the `alt` attribute is not technically required in HTML5 (as of the printing of this book).

Regardless, it's recommended to use the `alt` attribute whenever possible for images. Any decision to remove it, make it a null value, or use another method of providing text alternatives must be a conscious decision.

Apply these best practices when writing the text alternatives for images:

- Include all content (text) that appears in the image.
- Consider the context of the image to help determine what is important about it.
- If it is relevant, convey the purpose or function of the image.
- Avoid including information that is available as text near the image.
- Avoid including phrases such as “image of” or “picture of”.
- Be concise.

## Null alt Attribute

A null `alt` attribute is an `alt` attribute that contains no spaces or content. It is not the same as omitting the `alt` attribute.

```

```

Adding a null or empty `alt` attribute to the image is appropriate in the following situations:

- The image is purely decorative
- A text alternative is available immediately adjacent to the image
- The image is one of a group of images that form a larger picture, and one of the other images already has the text alternative for the entire picture
- The image is not meant to be seen by users like a 1-pixel image that counts page views

Or use `background-image` CSS properties to add a purely decorative image to the web page instead of using an `img` element.

The following CSS rule associates an image with a custom class, but the CSS could be associated with an HTML element, such as the `div` or `body` element.

```
.border {
  background-image: url(border_decoration.jpg);
  background-repeat: repeat-x;
}
```

Since assistive technology may completely ignore images that have a null `alt` attribute, assistive technology users will not be made aware of the existence of the image. Which might be exactly what you want since an image might be, as discussed, purely decorative without any substance to the web page's message.

However, if you omit the `alt` attribute altogether, the same assistive technologies announce that an image actually exists on the page and do their best to provide information about it, even if that information is only the file name.

Keep this in mind when considering whether to use a null `alt` attribute or omit the `alt` attribute. There is a difference in how some assistive technologies handle them.



Be advised that the `longdesc` attribute (see <http://www.w3.org/TR/REC-html40/struct/objects.html#edef-longdesc-IMG>) will likely be cut from HTML5.

In its place, either link to a page with a longer text alternative or provide that content adjacent to the image, as described in “[Getting Basic Geolocation Data](#)” on page 149.

## Using `figcaption`

In HTML5 an image may be enclosed in a `figure` element and the `figcaption` element may provide the entire text alternative or may supplement the text alternative provided in the image's `alt` attribute.

Some assistive technologies completely ignore images with an empty `alt` attribute.

To make the image discoverable, omit the `alt` attribute if you do not plan to include a value for it:

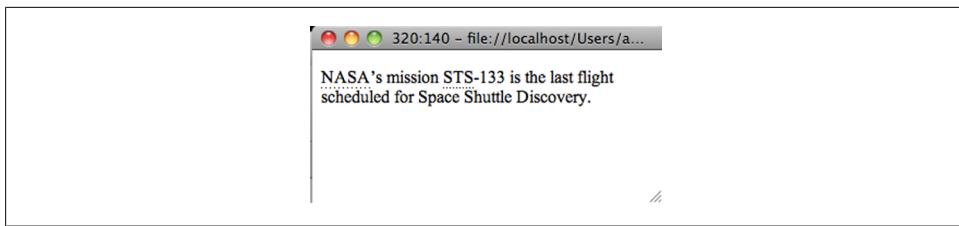


Figure 7-1. Abbreviations with a bottom border.

```
<figure>
  
  <figcaption>
    Opening ceremony for the new library building at the state university.
  </figcaption>
</figure>
```

## See Also

“HTML5: Techniques for providing useful text alternatives” at <http://dev.w3.org/html5/alt-techniques/>.

# Identifying Abbreviations and Acronyms

## Problem

You want to identify to users what an abbreviation or an acronym represents.

## Solution

Include the *full* expansion of the abbreviation in the page content.

Usually, one encloses the abbreviation in parentheses after the full expansion.

Include this at least the first time that the abbreviation appears on the page:

```
Web Content Accessibility Guidelines (WCAG) 2.0 was released as a World Wide Web Consortium (W3C) recom
```

## Using abbr

Use the `abbr` element to programmatically associate the full expansion with the abbreviation. The `abbr` element is an inline element that can be used within block elements or other inline elements.:.

```
<p><abbr title="Web Content Accessibility Guidelines">WCAG</abbr> 2.0 was released as a <abbr title="Wor
```

If the abbreviation is plural or possessive, ensure that the content within the `abbr` element matches what is included in the title attribute as shown in [Figure 7-1](#).

```
<p><abbr title="National Aeronautics and Space Administration">NASA</abbr>'s mission <abbr title="Space
```

## Discussion

The `acronym` element was deprecated in HTML5. This eliminated the XHTML quandary of when it was appropriate to use the `abbr` or the `acronym` element.

Now the `abbr` element simply covers both.

### Styling `abbr`

It's recommended to style the `abbr` element so that sighted users have a visual cue that there is additional content available to them.

The default styling for `abbr` in the Opera and Firefox browsers displays an underline, a dotted bottom border, beneath the text.

You can add this effect in Safari, Chrome, and Internet Explorer 8 with a single line of CSS.

```
abbr { border-bottom: 1px dotted black; }
```

Once user hovers their mouse over the abbreviation, most browsers display the full expansion of the abbreviation.



#### Abbreviation vs. Acronym

An abbreviation is the shortened form of a word or phrase, such as CSS or etc. An acronym is a type of abbreviation. It's a new word that's formed from the initial letters of a series of words. You pronounce those letters as a single word, such as NASA or NATO.

## See Also

For IE8 and below, see the WHATWG Blog's "Supporting New Elements in IE" work-around at <http://blog.whatwg.org/supporting-new-elements-in-ie>.

# Identifying Sections of a Page Using ARIA Landmark Roles

## Problem

You need a way to distinguish common sections of web content.

## Solution

Add ARIA "landmarks" to enhance recognition of HTML5 elements in assistive technology.

Since HTML5 is not supported by most assistive technology (as of the printing of this book), you can add ARIA landmark roles to help provide meaning to these new HTML elements.

The ARIA roles and HTML5 elements that are often associated together are listed below.

These are *not* hard and fast rules, but helpful suggestions. Use your best judgment.

## ARIA Roles

Add the **banner** role to the page header (logo, name, and other site-specific information). Use this role once only per document or web application.

```
<header role="banner">
```

Add the **complementary** role to the **aside** element. Both are designed to markup content that is somewhat related to the main content. Do not use this role or element for content that is completely separate and unrelated.

```
<aside role="complementary">
```

Add the **navigation** role to each **navigation** element.

```
<nav role="navigation">
```

Add the **form** role to any **form** element, unless the form contains search functionality.

```
<form role="form">
```

Add the **search** role to a site's search form.

```
<form role="search">
```

The **contentinfo** role identifies information about the page content, such as copyright and privacy terms. Use this role once only per document or web application. If your footer contains only this type of information, associate the role with the **footer** element.

```
<footer role="contentinfo">
  <p>Copyright 2011</p>
</footer>
```

If you have a “fat footer” with lots of other content or links, enclose the contentinfo material in a container element (like a **div** or a **p**) and assign the **contentinfo** role to the container.

```
<footer>
  ...
  <p role="contentInfo">Copyright 2011</p>
  ...
</footer>
```

## Roles for Web Apps

Some ARIA landmark roles such as **application** and **main** are unique and do not map directly to specific HTML5 elements.

Add the `application` role to an HTML element that contains a web application instead of normal web content.

Ensure that the HTML element associated with this role encompasses the entire web application. This role may instruct assistive technology to enter a mode that is more appropriate for interacting with web application functionality. You may add the `document` role to the page after the application to indicate where non-application web content resumes.

```
<div role="application">  
...  
</div>
```

Add the `main` role to an HTML element that contains the primary content of the document such as `article`, `div`, etc.

```
<div role="main">
```

In the future, this solution might provide an alternative to “skip to main content” or “skip navigation” links.

In other words, this role may provide a way for assistive technology users to jump directly to the page’s primary content and avoid going through long lists of links and content that are repeated on every page in the site.

If an article is the central content on a page, add the `main` role to the `article` element.

```
<article role="main">
```

## Discussion

ARIA extends the accessibility of HTML.

Assistive technologies can use ARIA landmark roles to identify and navigate to sections of content.

This may eventually replace the primitive “skip to main content” link technique used on some sites. These roles help provide a more reliable and consistent user experience.

While you are allowed to have more than one `nav` element per page, only main blocks of navigational links should be enclosed in a `nav` element. The `footer` element is an example of where links may exist that do not need a `nav` element. The `footer` element alone may be sufficient. Of course, if you create a “fat footer” like on the W3C site, it would be appropriate to use the `nav` element in the footer.



For more information about “fat footer” design, see the UI Patterns web site at <http://ui-patterns.com/patterns/FatFooter>.

## See Also

Summary of screen reader bugs with HTML5 elements combined with ARIA landmark roles at <http://www.accessibleculture.org/research/html5-aria>; workarounds for some assistive technology bugs at <http://www.accessibleculture.org/blog/2010/11/html5-plus-aria-sanity-check/>.

# Creating More Accessible Navigation Links

## Problem

You want to markup your navigational links in a way that will benefit the most users.

## Solution

Enclose the list of navigational links inside the HTML5 nav element.

Use an unordered list for the links if they can be visited in any order:

```
<nav role="navigation">
  <ul>
    <li><a href="#">Home</a></li>
    <li><a href="#">About</a></li>
    <li><a href="#">Blog</a></li>
    <li><a href="#">Portfolio</a></li>
  </ul>
</nav>
```

If the sequence of the links is important, use an ordered list to markup the navigational links:

```
<nav role="navigation">
  <ol>
    <li><a href="#">Chapter 1</a></li>
    <li><a href="#">Chapter 2</a></li>
    <li><a href="#">Chapter 3</a></li>
  </ol>
</nav>
```

Next, add a “skip navigation” link:

```
<div id="offscreen"><a href="#maincontent">Skip to the main content</a></div>
...
<nav role="navigation">
  <ul>
    <li><a href="#">Home</a></li>
    <li><a href="#">About</a></li>
    <li><a href="#">Blog</a></li>
    <li><a href="#">Portfolio</a></li>
  </ul>
</nav>
...
```

```
<article id="maincontent" role="main">  
  ...
```

This link may be placed before the navigation or closer to the top of the page, depending on how much content appears before the navigation. Its purpose is to provide keyboard and assistive technology users a way to go directly to the main content on the page.

## Discussion

A list, whether unordered or ordered, is generally considered the most appropriate HTML element to use for groups of navigational links ever since Christopher Schmitt first did it (see <http://www.alistapart.com/articles/practicalcss/>).

This markup can convey to assistive technology users how many navigational items are in the list and how far down the list the user is.

In the future, you might not need to add an ARIA role or skip links.

The user agent and assistive technology should recognize each section element and allow users to jump between page sections. In that future, all you would need is this:

```
<nav role="navigation">  
  <ul>  
    <li><a href="#">Home</a></li>  
    <li><a href="#">About</a></li>  
    <li><a href="#">Blog</a></li>  
    <li><a href="#">Portfolio</a></li>  
  </ul>  
</nav>  
  ...  
<article>
```

## Purpose of Skipping Links

The skip links prevent users from repeatedly going through the content and links that are listed on every page of a site. This is a critical addition to sites with long lists of links, such as news or ecommerce sites.

The easiest way to add a skip link is to add an anchor text link. The exact location on the screen doesn't matter, as long as the link is the first element in the page's tab order and that the link anchor is placed where the main content of the page begins.

## Hiding Skip to Main Content Links

If you need to "hide" the skip link from sighted users, use CSS to position the text off the screen. Before you do this, consider that sighted keyboard users may be confused because the text for the link will not be visible but the user will be able to tab to the link.

```
.offscreen {  
  left: -9999em;  
  position: absolute;  
  top: auto;
```

```
        overflow: hidden;  
        width: 1px;  
        height: 1px;  
    }  
  

```

Avoid using `display:none` for hiding skip links as screen readers might ignore the link altogether.

Instead of hiding the skip link, consider using CSS to stylize the link to match your design.

## See Also

- “[Identifying Sections of a Page Using ARIA Landmark Roles](#)” on page 135 for identifying sections of a page using ARIA Landmark roles.
- Article on using “skip navigation” links at <http://webaim.org/techniques/skipnav/>.

# Associating Form Fields with their Labels

## Problem

You need to identify the text label associated with each form field.

## Solution

Use the `label` element to programmatically associate text with its form field. The value of the label’s `for` attribute must match the value of the form field’s `id` attribute. This `id` value must be unique on each page:

```
<label for="fName">First Name</label>  
<input type="text" id="fname">
```

Do not include label elements for form fields of the type “hidden.”

### Multiple labels

Add the ARIA `labelledby` or `describedby` attributes if the form field needs multiple labels or descriptions for it to make sense. Both of these attributes can accept references to multiple values. Add a space between each value:

```
<form>  
  <fieldset>  
    <legend>Account Logout</legend>  
    <span id="labelAutoLogout">Automatically log out after</span>  
    <input id="autoLogout" type="text" value="30" aria-labelledby="labelAutoLogout autoLogout labelAutoLogout">
```

```
<span id="labelAutoLogoutTime">minutes of inactivity</span>
<p id="autoLogoutDesc">Allows you to customize the timeout period for each of your accounts.</p>
</fieldset>
</form>
```

## Discussion

The `label` element provides a caption for the associated form field. The `label` element is best for simple forms. ARIA is best suited for form fields that need multiple labels or whenever the `label` element isn't an option.

Keep in mind that a main difference between `aria-labelledby` and `aria-describedby` is that labels are intended to be *concise* while descriptions may be *wordier* and include more detail.

## See Also

HTML5 `label` specification at <http://dev.w3.org/html5/markup/label.html>.

# Grouping Form Fields Logically

## Problem

You need to group related fields within a form.

## Solution

Add the `fieldset` element around each group of related form fields. Add a `legend` as the first element within the `fieldset`. The `legend` represents a caption or title for the group of fields:

```
<form>
  <fieldset>
    <legend>Movie Rating</legend>
    <p><input type="radio" name="rating" id="rating1">
      <label for="rating1">Excellent</label></p>
    <p><input type="radio" name="rating" id="rating2">
      <label for="rating2">Good</label></p>
    <p><input type="radio" name="rating" id="rating3">
      <label for="rating3">Fair</label></p>
    <p><input type="radio" name="rating" id="rating4">
      <label for="rating4">Poor</label></p>
  </fieldset>
</form>
```

Also, do your best to keep the legend text brief.

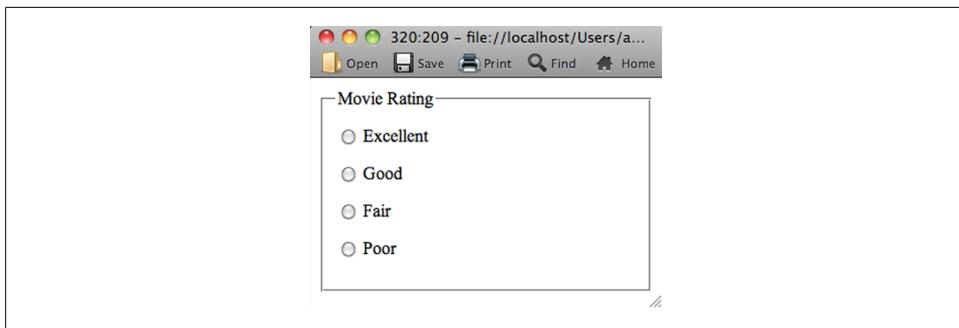


Figure 7-2. The default appearance of `fieldset` and `legend` in Opera 11.



Some assistive technologies announce the legend before the label for every field in the `fieldset`. That could get quite repetitive.

## Discussion

Using the `fieldset` element to organize form fields helps users understand the purpose of the form and what's related, as shown in [Figure 7-2](#). A `fieldset` may also be used to group sets of radio buttons or checkboxes.

The `legend` and `fieldset` can both be styled using CSS. By default, most browsers display a solid one-pixel border around the `fieldset` and the legend appears in the upper left of the container, overlaying the border.

Another benefit of grouping the form fields using the `fieldset` element is that the flow, or ordering, of the form should make sense to keyboard users.

Unless you do something like modify the `tabindex` values, the tab order of a form usually follows the order that the fields appear in the source code.

The field order used to be more of a problem when tables were used for form layout. The use of CSS for layout has greatly mitigated this problem because the fields can be listed in a logical order in the source code and then positioned on the screen, independent of the code order.

## See Also

- “Making Elements Focusable with Tabindex” at [http://snook.ca/archives/accessibility\\_and\\_usability/elements\\_focusable\\_with\\_tabindex](http://snook.ca/archives/accessibility_and_usability/elements_focusable_with_tabindex).
- HTML5 `fieldset` specification at <http://dev.w3.org/html5/markup/fieldset.html>.

# Enabling a fieldset Dynamically

## Problem

You want to disable the fields in a `fieldset` and dynamically enable them when some other condition is met, such as the user selecting a radio button or checkbox.

## Solution

Add the `fieldset` and `legend` elements around a group of related form fields that will be hidden.

Add the `disabled` attribute on the two nested `fieldset` elements. Add an `onchange` event to each radio button to trigger the change.

```
<form>
  <fieldset>
    <legend>Store Credit Card</legend>
    <p><label>Name displayed on your card:<input name="fullName" required></label></p>
      <fieldset name="accountNum" disabled>
        <legend>
          <label>
            <input type="radio" name="accountType" onchange="form.accountNum.disabled = !checked; form.accountLetters.disabled = !checked;">
          </label>
        </legend>
        <label>
          <input type="radio" name="accountType" onchange="form.accountLetters.disabled = !checked; form.accountNum.disabled = !checked;" checked="checked">
        </label>
      </fieldset>
      <fieldset name="accountLetters" disabled>
        <legend>
          <label>
            <input type="radio" name="accountType" onchange="form.accountLetters.disabled = !checked; form.accountNum.disabled = !checked;">
          </label>
        </legend>
        <label>
          <input name="cardNum" required>
        </label>
      </fieldset>
    </fieldset>
  </form>
```

If the radio button is not selected, everything inside the nested `fieldset` will be disabled.

Selecting a radio button removes the `disabled` attribute on that `fieldset` to make the associated input field editable and adds the `disabled` attribute to the `fieldset` associated with the other radio button.



Note that `fieldsets` can be nested.

## Discussion

While there are other ways to dynamically enable form fields, this method is one future possibility that takes advantage of the new `disabled` attribute added for `fieldsets` in HTML5.

Depending on how user agents support the `disabled` attribute, you may need to add scripts that dynamically set the `disabled` attribute on the `fieldset` instead of hard coding the attribute.

## See Also

The W3C's HTML5 Edition for Web Authors draft on forms at

<http://dev.w3.org/html5/spec-author-view/forms.html>.

## Identifying Required Form Fields

### Problem

You want to indicate to users visually and programmatically which form fields are required.

### Solution

If every field is required, include text instructions at the top of the form informing users that everything's required. This works fine if the form is short.

#### Write Out Required

If you need to accommodate internationalization (IL8N) or users with low vision, place the label on a separate line. Include “(Required)” within each label element for required fields:

```
<p><label for="fName">First Name (Required)</label></p>
<p><input type="text" id="fname"></p>
```

If the design dictates that the label and field must be on the same line, add an image icon within the label element. Set the value of the image `alt` attribute as “Required”:

```
<label for="fName">
  
  First Name
</label>
<input type="text" id="fname">
```

## Using ARIA

If the design dictates that the label and field must be on the same line, add an image icon within the label element.

Set the value of the image `alt` attribute as “Required.” Set the value of the image `role` attribute as “presentation.” Add the `aria-required=true` attribute to the input field.

Newer assistive technology that supports ARIA ignores the image icon because elements with the presentation role are intentionally ignored by (and not mapped to) accessibility APIs.

However, the newer assistive technology should recognize the `aria-required` attribute and announce that the field is required. This solution also works for older assistive technology that does not support ARIA because it ignores all of the ARIA attributes, and instead provide the `alt` attribute of “Required” on the icon image. The required icon images can be left aligned to make visual scanning easier for sighted users:

```
<label for="fName">
  
  First Name
</label>
<input type="text" id="fname" aria-required="true">
```

## Discussion

It may take a while until browsers and assistive technologies support the HTML5 `required` attribute on the `input` element.

The meaning of the `strong` element is changing in HTML5, though not substantially. It would still be appropriate to use it around the asterisk that represents a required field because typically required fields must contain values before the user proceeds.

### The required attribute

What you probably wanted to see was the HTML5 `required` attribute on the `input` element. It may take a while until browsers and assistive technologies support this. For sighted users, you could use CSS to style the appearance of the field or you could add a styled asterisk so they can visually scan the screen for required fields:

```
<label for="fName">
  <strong>*</strong>
  First Name
</label>
<input type="text" id="fname" required>Discussion
```

## See Also

- “ARIA and Progressive Enhancement” by Derek Featherstone at <http://www.alistapart.com/articles/aria-and-progressive-enhancement>.

- “Future Web Accessibility: HTML5 `input` Extensions” at <http://webaim.org/blog/future-web-accessibility-html5-input-extensions>.

## Using ARIA Live Regions to Announce When Dynamic Content Is Updating

### Problem

You want to notify users when parts of the web page that do not have focus, but are dynamically updating.

### Solution

First, assign the `aria-live` attribute to the HTML element where a content change or update may occur and decide the urgency of communicating the update.

Then, select a standard live region role. Assign the role to the parent HTML element that contains the content that may change. If the default behaviors for the role are appropriate, you won’t need to specify attributes.

```
<div role="alert">
```

The standard live regions roles include:

#### `alert`

Use it for a single, time-sensitive notification. It will be handled as an assertive live region and the update will appear immediately. An alert cannot receive focus, and therefore, cannot be closed by the user.

#### `alertdialog`

This type of alert message can receive focus. When the alert appears, you must automatically set focus on an active element in the alert dialog, such as an “OK” button. Include the `aria-describedby` attribute on that active element to point to the message in the dialog.

#### `log`

Use it for things like message history or error logs. New information is added to the end of the log and the oldest information may disappear.

#### `marquee`

Use it for things like stock tickers or ad banners. This is similar to a log because information may change frequently.

#### `status`

Use it for a minor notification that does not warrant use of an alert. It will be handled as an assertive live region. A status should not receive focus. If a different

part of the page drives the status changes, use the `aria-controls` attribute to identify the relationship.

#### timer

Use it to display time elapsed or remaining. Update the timer at fixed intervals unless the timer is paused or reached the end of its count.

If you need something other than the standard ARIA live region roles and behaviors, you can create a custom live region.

### Custom Live Regions

First, identify where a content change or update may occur and decide how urgently the update needs to be communicated.

Next, assign the `aria-live` attribute to the parent HTML element that contains the content that may change. The value for the `aria-live` attribute will reflect how quickly the update will be communicated to users. The available values are:

- `aria-live="off"` where the update is not announced
- `aria-live="polite"` where the update is announced when the user is idle or finishes with their current activity
- `aria-live="assertive"` where the update is announced as soon as possible, even if it means interrupting the user's current task

Avoid using `aria-live="assertive"` unless it's critical to communicate the change immediately. Users may consider the disruption jarring and rude.

```
<div aria-live="polite">
```

Then, decide how much context is required for the user to understand the update. If the entire live region must be presented for the change to make sense, assign the `aria-atomic` attribute with the value of `true` to the HTML element.

Repeating unchanged information may become redundant or make it harder to distinguish what portion changed. If you want to communicate *only* the change and that change makes sense on its own, assign the `aria-atomic` attribute with the value of `false` to the HTML element.

```
<div aria-live="polite" aria-atomic="false">
```

Finally, identify the type of update. Assign the `relevant` attribute to the HTML element. The types of update are:

- `relevant="additions"` where new nodes are added to the DOM
- `relevant="removals"` where nodes are removed from the DOM
- `relevant="text"` where changes occur to the text within existing nodes

You may assign multiple values to the relevant attribute by adding a space between values. In fact, the default behavior should be `relevant="additions text"`. This reflects the most common type of changes.

```
<div aria-live="polite" aria-atomic="false" relevant="additions removals text">
```

## Discussion

ARIA Live Regions provides a standardized way to alert assistive technology that a DOM change has occurred and how to handle the change.

You may also prevent updates from being announced until all of the changes in a live region finish updating by changing the live region's state. This is done by dynamically setting the attribute state `aria-busy="true"` and then clearing it when the updates are ready to be announced. This might be useful when multiple updates in a live region need to be announced together to make sense.

## See Also

- The WAI-ARIA 1.0 Roles Model at <http://www.w3.org/WAI/PF/aria/roles>
- ARIA Live Regions test examples: <http://test.cita.illinois.edu/aria/live/live1.php>
- The Juicy Studio Accessibility toolbar for Firefox to examine ARIA live regions: <https://addons.mozilla.org/en-US/firefox/addon/juicy-studio-accessibility-tool/>

# GeoLocation

*Christopher Deutsch and Marc Grabanski*

## Introduction

The HTML5 specification includes a new Geolocation API, which allows for scripted access to geographical location information associated with the a device's browser. We're going to cover how to access this API and then dive into some examples of what you can do with this data using Google Maps and other 3rd party libraries like SimpleGeo.

All of the examples in this chapter use jQuery (see <http://jquery.com/>), which can easily be included using a script tag in one of two ways.

There is no need to download the `jquery.js` file, your web page can use the version hosted on Google's Content DeliveryNetwork (CDN):

```
<script src="//ajax.googleapis.com/ajax/libs/jquery/1.5.2/jquery.js"></script>
```

Just in case a call to the file across the Internet isn't available, a fallback to a local copy of the jQuery file can come right afterwards in a second script element that checks for the previous copy's successful inclusion:

```
<script src="//ajax.googleapis.com/ajax/libs/jquery/1.5.1/jquery.js"></script>
<script>window.jQuery || document.write("<script src='js/libs/jquery-1.5.2.min.js'>\x3C/script>")</script>
```

## Getting Basic GeoLocation Data

### Problem

You want to find the location of the user's Internet device.

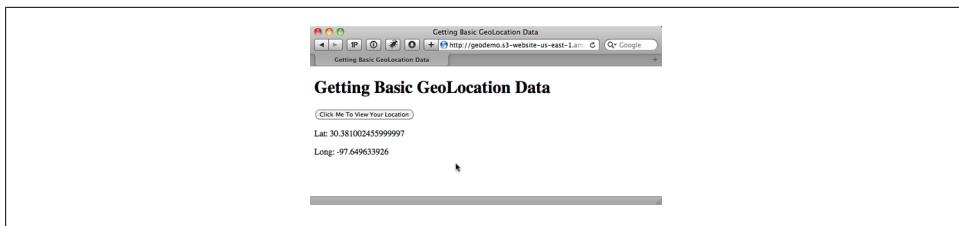


Figure 8-1. The latitude and longitude coordinates determined natively through the browser.

## Solution

Use the new HTML5 GeoLocation API to get the user's location when they click a button and output the values to the web page as shown in [Figure 8-1](#).

Start by adding an input button to the page.

```
<input type="button" id="go"
       value="Click Me To View Your Location" />
```

Next add the following JavaScript to handle the button's click event, access the Geolocation API, and output the results.

```
<script>
$(document).ready(function () {
    //wire up button click.
    $('#go').click(function () {
        //test for presence of geolocation.
        if (navigator && navigator.geolocation) {
            navigator.geolocation.getCurrentPosition(geo_success, geo_error);
        } else {
            error('GeoLocation is not supported.');
        }
    });
}

function geo_success(position) {
    printLatLong(position.coords.latitude, position.coords.longitude);
}

// The PositionError object returned contains the following attributes:
// code: a numeric response code.
// PERMISSION_DENIED = 1
// POSITION_UNAVAILABLE = 2
// TIMEOUT = 3
//message: Primarily for debugging. It's recommended not to show this error to users.
function geo_error(err) {
    if (err.code == 1) {
        error('The user denied the request for location information.')
    } else if (err.code == 2) {
        error('Your location information is unavailable.')
    } else if (err.code == 3) {
        error('The request to get your location timed out.')
    } else {
        error('An unknown error occurred while requesting your location.')
    }
});
```

```

        }
    }

//output lat and long .
function printLatLong(lat, long) {
    $('body').append('<p>Lat: ' + lat + '</p>');
    $('body').append('<p>Long: ' + long + '</p>');
}

function error(msg) {
    alert(msg);
}
</script>

```

## Discussion

The `navigator` object gives us access to the new `geolocation` object. The `geolocation` object has the following methods:

- `getCurrentPosition` returns the user's current position.
- `watchPosition` returns the user's current position, but also continues to monitor the position and invoke the appropriate callback every time the position changes.
- `clearWatch` this method ends the `watchPosition` method's monitoring of the current position.

When determining the location of the Internet device, first check that the user's browser supports the GeoLocation feature natively. If it does, call the `getCurrentPosition` method:

```

if (navigator && navigator.geolocation) {
    navigator.geolocation.getCurrentPosition(geo_success, geo_error);
} else {
    error('GeoLocation is not supported.');
}

```

Since this method executes asynchronously, pass it two callback functions: `geo_success` and `geo_error`. The error callback is passed a `position_error` object that contains a `code` and a `message` property. The `code` can be one of the following:

- 0 - Unknown
- 1 - Permission Denied
- 2 - Position Unavailable
- 3 - Timeout

The success callback is passed a `position` object that contains a `coordinates` object and a timestamp. The `coordinates` object contains the following:

- `latitude`, which is specified in decimal degrees.
- `longitude`, which is specified in decimal degrees.

- `altitude`, which is specified in meters above the ellipsoid.
- `accuracy`, which is specified in meters.
- `altitudeAccuracy`, which is specified in meters.
- `heading`, which is direction of travel specified in degrees.
- `speed`, which is specified in meters per second.

Of those 7, only 3 are guaranteed to be there: `latitude`, `longitude`, and `accuracy`.

For the Solution, take the `latitude` and `longitude` and append them to the body of our web page using jQuery:

```
function printLatLong(lat, long) {  
    $('body').append('<p>Lat: ' + lat + '</p>');  
    $('body').append('<p>Long: ' + long + '</p>');  
}
```

## See Also

W3C Geolocation Specification at <http://dev.w3.org/geo/api/spec-source.html>.

# Basic GeoLocation Data with Fallback

## Problem

You want to determine a user's Internet location when a browser does not support the HTML5 GeoLocation API natively.

## Solution

Perform an IP to Location lookup as a fallback. It's certainly not as accurate as latitude and longitude coordinates, but it's far better than not having any location data at all.

### Google vs MaxMind

Google offers the `google.loader.ClientLocation` object in its Google Maps API v3 library, but it does not work for many U.S. IP addresses.

The MaxMind GeoIP JavaScript Web Service seems more accurate and up to date. Also, it's free as long as you link back to the <http://www.maxmind.com>. web site. Alternatively they offer a JavaScript attribution-free license that can be purchased for \$250/year.

### Coding the Solution

Modify our previous example to use MaxMind as a fallback.

Start by adding the JavaScript library to the page:

```
<script src="http://j.maxmind.com/app/geoip.js"></script>
```

Now let's modify the previous example to fallback to MaxMind:

```
$(document).ready(function () {
    //wire up button click.
    $('#go').click(function () {
        //test for presence of geolocation.
        if (navigator && navigator.geolocation) {
            //make the request for the user's position.
            navigator.geolocation.getCurrentPosition(geo_success, geo_error);
        } else {
            //use MaxMind IP to location API fallback.
            printLatLong(geoip_latitude(), geoip_longitude(), true);
        }
    });
});

//output lat and long .
function printLatLong(latitude, longitude, isMaxMind) {
    $('body').append('<p>Lat: ' + latitude + '</p>');
    $('body').append('<p>Long: ' + longitude + '</p>');
    //if we used MaxMind for location add attribution link.
    if (isMaxMind) {
        $('body').append('<p><a href="http://www.maxmind.com" target="_blank">IP to Location Service Pro')
    }
}

function geo_error(err) {
    //instead of displaying an error, fallback to MaxMind IP to location library.
    printLatLong(geoip_latitude(), geoip_longitude(), true);
}
```

## Discussion

Instead of showing an error if `navigator` or `navigator.geolocation` are undefined, use the `geoip_latitude()` and `geoip_longitude()` functions that the MaxMind JavaScript library provides us to retrieve the user's latitude and longitude.

Looking at the source of the MaxMind `geoip.js` file, they've already translated your IP address into location data. MaxMind creates a dynamic JavaScript file by reading the IP address that made the HTTP request and doing the IP to Location translation server side and then outputting the results.

In addition to latitude and longitude, the following location data is available as shown in [Table 8-1](#):

*Table 8-1. Location data examples from MaxMind geoip.js*

Method	Description	Example Data
<code>geoip_country_code()</code>	Country Code	US
<code>geoip_country_name()</code>	Country Name	United States

Method	Description	Example Data
geoip_city()	City	Minneapolis
geoip_region_name()	Region	MN
geoip_region_name()	Region Name	Minnesota
geoip_postal_code()	Postal Code	55401
geoip_area_code()	Telephone Area Code	612
geoip.metro_code()	Metro Code	613

When calling `printLatLong` using MaxMind, pass in an extra true parameter.

The free version of MaxMind requires attribution in the form of a link back to their site, so the `isMaxMind` parameter has been added to the `printLatLong` function to indicate that MaxMind was used to get the Location:

```
function printLatLong(latitude, longitude, isMaxMind) {
    $('body').append('<p>Lat: ' + latitude + '</p>');
    $('body').append('<p>Long: ' + longitude + '</p>');
    //if we used MaxMind for location add attribution link.
    if (isMaxMind) {
        $('body').append('<p><a href="http://www.maxmind.com" target="_blank">IP to Location Service Pro')
    }
}
```

Another scenario to be mindful of is if the user denies our request for location information or something else goes wrong. That's why the `geo_error()` handler is changed to also fallback to using IP to Location.

Because we've added MaxMind as a fallback, the solution is able to handle a larger percentage of browsers and devices without having to rely on native GeoLocation support in the browser.

## See Also

MaxMind provides free/open source Geolocation solutions for city, country, and IP lookups at <http://www.maxmind.com/app/ip-location>.

# Reverse Geocoding an Address with Latitude and Longitude

## Problem

You want to convert latitude and longitude coordinates into a human-friendly address.

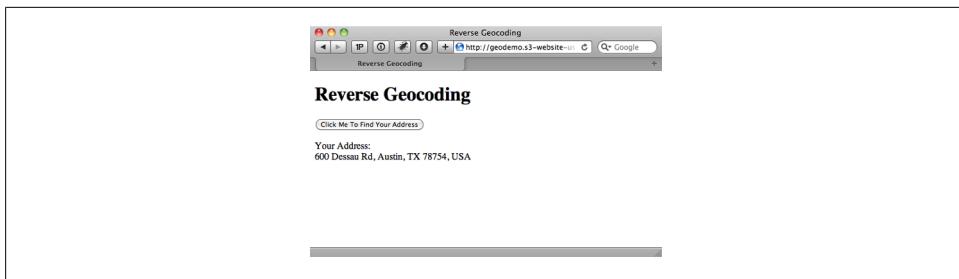


Figure 8-2. Determining a user's address.

## Solution

Use the Google Maps JavaScript API to turn latitude and longitude into an address as shown in [Figure 8-2](#).

The process of turning geographic data like street address and zip code into geographic coordinates such as latitude and longitude is called *geocoding* (we'll get to this in the next recipe). Doing the opposite, turning coordinates into an address, is called *reverse geocoding*.

Begin by adding the needed scripts to our web page:

```
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.4.4/jquery.js"></script>
<script src="http://j.maxmind.com/app/geoip.js"></script>
<script src="http://maps.google.com/maps/api/js?sensor=false"></script>
```

Add a button to trigger getting the user's coordinates and looking up the address:

```
<input type="button" id="go" value="Click Me To Find Your Address" />
```

Next add the JavaScript to handle the button click and `getCurrentPosition` success callback:

```
$(document).ready(function () {

    //wire up button click.
    $('#go').click(function () {
        //test for presence of geolocation.
        if (navigator && navigator.geolocation) {
            //make the request for the user's position.
            navigator.geolocation.getCurrentPosition(geo_success, geo_error);
        } else {
            //use MaxMind IP to location API fallback.
            printAddress(geoip_latitude(), geoip_longitude(), true);
        }
    });

    function geo_success(position) {
        printAddress(position.coords.latitude, position.coords.longitude);
    }

    function geo_error(err) {
```

```

//instead of displaying an error, fallback to MaxMind IP to location library.
printAddress(geoip_latitude(), geoip_longitude(), true);
}

////use google maps API to revers Geocode our location.
function printAddress(latitude, longitude, isMaxMind) {
    //setup the Geocoder object.
    var geocoder = new google.maps.Geocoder();

    //turn coordinates into an object.
    var yourLocation = new google.maps.LatLng(latitude, longitude);

    //find out info about our location.
    geocoder.geocode({ 'latLng': yourLocation }, function (results, status) {
        if (status == google.maps.GeocoderStatus.OK) {
            if (results[0]) {
                $('body').append('<p>Your Address:<br />' + results[0].formatted_address + '</p>');
            } else {
                error('Google did not return any results.');
            }
        } else {
            error("Reverse Geocoding failed due to: " + status);
        }
    });

    //if we used MaxMind for location add attribution link.
    if (isMaxMind) {
        $('body').append('<p><a href="http://www.maxmind.com" target="_blank">IP to Location Service Pro');
    }
}

function error(msg) {
    alert(msg);
}

```

## Discussion

Get the coordinates from `getCurrentPosition` and pass them to a `printAddress` function, which uses the Google Maps API to do the reverse geocoding.

The `printAddress` function begins by creating a new Google `Geocoder` object. The `Geocoder` object gives us access to the `geocode` method, which can take in a variety of options and return information based on them.

In our case, use the `google.maps.LatLng` method to create a new Google `LatLng` object that is passed into `geocode` in order to get the address. The `geocode` method is asynchronous just like `getCurrentPosition`, so define an inline JavaScript function to handle the callback.

The callback's response contains two parameters, one for the results and the other for the status code. If the status is `Ok` then it's safe to parse the array of `GeocoderResults`

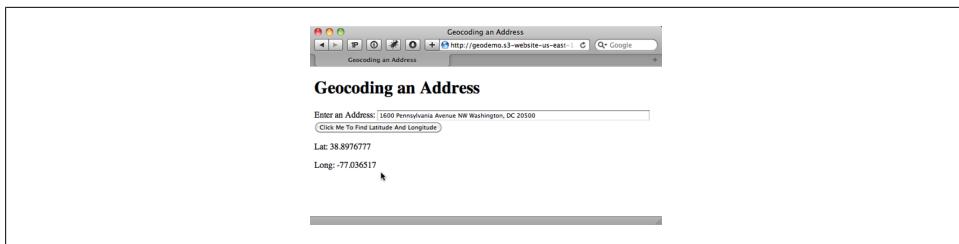


Figure 8-3. Determining an address based on human-friendly address

objects stored in the results variable. The `results` variable is an array since `Geocoder` may return more than one entry.

Next, check for a `GeocoderResults` object in the first position of the array and, if it exists, append the `formatted_address` property to the web page's body.

## See Also

More information about reverse geocoding, see <http://code.google.com/apis/maps/documentation/javascript/services.html#ReverseGeocoding>.

# Convert an Address into Latitude and Longitude

## Problem

You want to turn an address into latitude and longitude coordinates.

## Solution

Use the Google Maps JavaScript API V3 to turn an address into latitude and longitude as shown in [Figure 8-3](#). This is called *geocoding*.

Include jQuery and Google Maps JavaScript API V3 in the Web page:

```
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.4.4/jquery.js"></script>
<script src="http://maps.google.com/maps/api/js?sensor=false"></script>
```

The HTML5 GeoLocation API can only return the user's location in coordinates so let the user enter their address via an input text field:

```
<div>
    <label for="address">Enter an Address:</label>
    <input type="text" id="address" />
</div>
<div>
    <input type="button" id="go" value="Click Me To Find Latitude And Longitude" />
</div>
```

The JavaScript below handles the button click, reading the input from the user, and calls the Google API to geocode the address:

```
$(document).ready(function () {  
  
    //wire up button click.  
    $('#go').click(function () {  
        //get the address the user entered.  
        var address = $('#address').val();  
        if (address) {  
            //use google maps API to Geocode the address.  
            //setup the Geocoder object.  
            var geocoder = new google.maps.Geocoder();  
            //return the coordinates.  
            geocoder.geocode({ 'address': address }, function (results, status) {  
                if (status == google.maps.GeocoderStatus.OK) {  
                    if (results[0]) {  
                        //print results  
                        printLatLong(results[0].geometry.location.lat(), results[0].geometry.location.lng());  
                    } else {  
                        error('Google did not return any results.');  
                    }  
                } else {  
                    error("Reverse Geocoding failed due to: " + status);  
                }  
            });  
        } else {  
            error('Please enter an address');  
        }  
    });  
  
});  
  
//output lat and long .  
function printLatLong(lat, long) {  
    $('body').append('<p>Lat: ' + lat + '</p>');  
    $('body').append('<p>Long: ' + long + '</p>');  
}  
  
function error(msg) {  
    alert(msg);  
}
```

## Discussion

When the user clicks the button, use jQuery to read the value and validate it's not blank. Next, create an instance of the `Geocoder` object. In order to do so call the `geocode` method, but pass an `address` option instead of latitude and longitude:

```
//setup the Geocoder object.  
var geocoder = new google.maps.Geocoder();
```

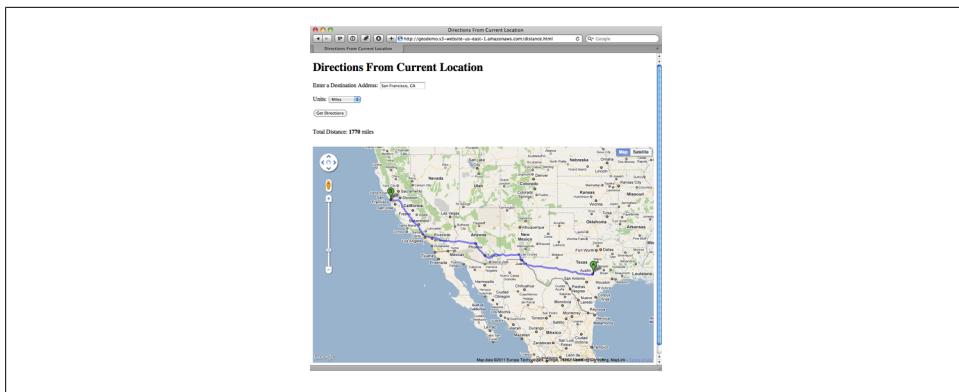


Figure 8-4. Determining the directions from a location.

```
//return the coordinates.  
geocoder.geocode({ 'address': address }, function (results, status) {  
  ...
```

Then access the `geometry` property of the `GeocoderResults` object. The `geometry` property contains a `location` property that can then be used to call the `lat` and `lng` methods to get our address's coordinates, which then is appended to the web page body in our `printLatLong` function:

```
//print results  
printLatLong(results[0].geometry.location.lat(), results[0].geometry.location.lng());
```

## See Also

More information about geocoding, see <http://code.google.com/apis/maps/documentation/geocoding/>.

# Directions From Current Location

## Problem

You want to get directions from the user's current location to a specific address.

## Solution

Use the Google Maps API to display the route the same way the Google Maps website would, and give the user the option to output the distance in miles or kilometers as shown in [Figure 8-4](#).

Use the jQuery and Google Maps JavaScript API V3 libraries:

```
<script src="http://maps.google.com/maps/api/js?sensor=false"></script>
<script src="http://j.maxmind.com/app/geoip.js"></script>
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.4.4/jquery.js"></script>
```

The HTML is similar to the geocoding example with the addition of a dropdown box to select miles or kilometers, and instead of appending our results to the page body, we'll add a `div` to hold the calculated distance and a `div` to hold the Google Map:

```
<div class="field">
  <label for="address">Enter a Destination Address:</label>
  <input type="text" id="address" />
</div>

<div class="field">
  <label for="units">Units:</label>
  <select id="units">
    <option value="IMPERIAL">Miles</option>
    <option value="METRIC">Kilometers</option>
  </select>
</div>

<div>
  <input type="button" id="go" value="Get Directions" />
</div>

<div id="distance"></div>

<div id="map"></div>
```

The JavaScript below does the following:

- Display a map of the United States on page load.
- Handle the button click.
- Get the user's current location.
- Read the address input.
- Pass the current location and address to the Google API to get the driving distance between the two locations.
- Update the Google Map with the suggested driving route.

```
//google maps globals:
var directionRenderer;
var directionsService = new google.maps.DirectionsService();
var map;

$(document).ready(function () {

  /////setup map starting point for Google Maps
  //set initial coords to latitude -92 and longitude 32 which is somewhere around Kansas City in the
  // and then set the zoom to 4 so the entire US is visible and centered.
  var kansas = new google.maps.LatLng(32, -92);
  var myOptions = {
    zoom: 4,
    mapTypeId: google.maps.MapTypeId.ROADMAP,
```

```

        center: kansas
    }
map = new google.maps.Map(document.getElementById("map"), myOptions);
directionsRenderer = new google.maps.DirectionsRenderer();
directionsRenderer.setMap(map);

//wire up button click.
$('#go').click(function () {
    //use our new getLatLng with fallback and define an inline function to handle the callback.
    getLatLng(function (latitude, longitude, isMaxMind) {
        //set the starting point.
        var start = new google.maps.LatLng(latitude, longitude);

        //get the address the user entered.
        var address = $('#address').val();
        if (address) {
            //set end point.
            var end = $('#address').val();

            //set the request options:
            var request = {
                origin: start,
                destination: end,
                travelMode: google.maps.DirectionsTravelMode.DRIVING
            };

            //make the directions request.
            directionsService.route(request, function (result, status) {
                if (status == google.maps.DirectionsStatus.OK) {

                    //display the directions using Google's Directions Renderer
                    directionsRenderer.setDirections(result);

                    ////output total distance separately.
                    var distance = getTotalDistance(result);
                    //output either miles or km
                    var units = $('#units').val();
                    if (units == 'IMPERIAL') {
                        $('#distance').html('Total Distance: <strong>' + metersToMiles(distance) + '</strong>');
                    } else {
                        $('#distance').html('Total Distance: <strong>' + metersToKilometers(distance) + '</strong>');
                    }

                } else {
                    error("Directions failed due to: " + status);
                }
            });
        }
    }
    else {
        error('Please enter an address');
    }
}

//if we used MaxMind for location add attribution link.
if (isMaxMind) {

```

```

        $('body').append('<p><a href="http://www.maxmind.com" target="_blank">IP to Location Services</a></p>');
    });
});

function getLatLang(callback) {
    //test for presence of geolocation.
    if (navigator && navigator.geolocation) {
        //make the request for the user's position.
        navigator.geolocation.getCurrentPosition(function (position) {
            //success handler
            callback(position.coords.latitude, position.coords.longitude);
        },
        function (err) {
            //handle the error by passing the callback the location from MaxMind.
            callback(geoip_latitude(), geoip_longitude(), true);
        });
    } else {
        //geolocation not available so pass the callback the location from MaxMind.
        callback(geoip_latitude(), geoip_longitude(), true);
    }
}

//returns total distance in meters.
function getTotalDistance(result) {
    var meters = 0;
    var route = result.routes[0];
    for (ii = 0; ii < route.legs.length; ii++) {
        //google stores distance value in meters.
        meters += route.legs[ii].distance.value;
    }
    return meters;
}

function metersToKilometers(meters) {
    return Math.round(meters / 1000);
}

function metersToMiles(meters) {
    //1 Mile = 1609.344 Meters
    return Math.round(meters / 1609.344);
}

function error(msg) {
    alert(msg);
}

```

## Discussion

To build out the solution, start by defining three global variables that are used to communicate with the Google API and to update our `#map` div.

When the document loads, set the map of the U.S. to be displayed. The Google Map object represents a map on your web page (you can have more than one).

Create a `Map` object by calling `new google.maps.Map(document.getElementById("map"), myOptions)`, and passing in the HTML element where we want to display the map and a `Map options` object.

There are many options that can be set, but the three used for this Solution are `zoom`, `mapTypeId`, and `center`. The options are fairly descriptive as to their purpose. Set `zoom` to 4 to allow the user to see the entire U.S. For the `mapTypeId`, use `ROADMAP`, which displays the normal, default 2D tiles of Google Maps. The other options are `SATELLITE`, `HYBRID`, and `TERRAIN`. The `center` option indicates the location that is displayed in the center of the map.

The latitude and longitude of Kansas, which is a central location in the U.S., are hard-coded to create a `LatLng` object that can be used to set the `center` parameter. When the `Map` object is created using the `new` keyword it, automatically updates our map `div`.

The next line, `directionsRenderer = new google.maps.DirectionsRenderer();` creates a new `DirectionsRenderer` object that can automatically update Maps for us. The line `directionsRenderer.setMap(map);` doesn't do anything yet, but it tells user to enter an address and click the button.

In this example, re-factored logic does a GeoLocation fallback in order to be a little more compact and re-usable:

```
function getLatLang(callback) {
    //test for presence of geolocation.
    if (navigator && navigator.geolocation) {
        //make the request for the user's position.
        navigator.geolocation.getCurrentPosition(function (position) {
            //success handler
            callback(position.coords.latitude, position.coords.longitude);
        },
        function (err) {
            //handle the error by passing the callback the location from MaxMind.
            callback(geoip_latitude(), geoip_longitude(), true);
        });
    } else {
        //geolocation not available so pass the callback the location from MaxMind.
        callback(geoip_latitude(), geoip_longitude(), true);
    }
}
```

The function takes a single callback parameter that returns the `latitude`, `longitude`, and `isMaxMind` variables.

Check for the existence of `navigator.geolocation` just like before, but this time define the `navigator.geolocation` callback handlers inline to call our common callback function. That returns either the results of `getCurrentPosition` or the MaxMind latitude and longitude.

For the button click handler in the main example, start off by using the new `getLatLang` function to collect the user's current location, which then is used to create a new `LatLang` object and store it in the `start` variable.

Next, collect the address and store the text as a string in the `end` variable.

To get the directions, use the `DirectionsService` object that was created and stored into the global variable `directionsService`. The `route` method of the `DirectionsService` object takes a `DirectionsRequest` object parameter and a callback method. The `DirectionsRequest` object supports many options, but the Solution only needs to set the `origin`, `destination`, and `travelMode` options.



We could make an API request to geocode the address and get its coordinates, but the Google API handles that automatically in the next step.

The `origin` and `destination` options can be either strings like the `end` variable or the `LatLang` values. For the `travelMode` option, set it to `DRIVING`. (The other options are `WALKING` or `BICYCLING`.)

The `route` method executes asynchronously, so define a callback function that is passed a `DirectionsResult` object and a `status` code. Check the `status` variable to make sure the `route` method finished successfully and then pass the `result` object to the `DirectionsRenderer` object that updates the map with a highlighted driving route between our start and end locations.

To give you an idea of what is contained in the `result` variable, pass it to the `getTotalDistance` function, which is responsible for totaling the distance of the driving route. The `result` object contains a `routes` property, which is an array of `DirectionsRoute` objects. Each route indicates a way to get from the start to the end location. Usually only one route is returned unless you set the `provideRouteAlternatives` option to `true`.

Our `getTotalDistance` function only looks at the first route. Each `DirectionsRoute` object contains multiple properties, but the property needed is `legs`, which is an array of `DirectionsLeg` objects that defines a single leg of the journey between the start and end location.

If the route does not contain any `waypoints` the route only has a single leg. Since waypoints were not defined, the results should have a single leg, but for good measure loop through each leg anyway.

Like the route object, the leg object also contains multiple properties, but the only one necessary to access is the `distance` property, which contains a `DirectionsDistance` object. The `value` property of the `DirectionsDistance` object gives the total distance of the leg in meters. The loop adds up the distance of each leg and returns the total in meters.

Finally, check the value of the units' dropdown to find out if the user wanted the total distance in miles or kilometers.

Then call one of our helper functions `metersToKilometers` or `metersToMiles` to convert meters into kilometers or miles respectively, and output the value to the `distance` `div` element.

## See Also

More about directions from Google Maps API, see <http://code.google.com/apis/maps/documentation/javascript/services.html#Directions>.

# Starbucks to Starbucks

## Problem

You want to get directions from the nearest Starbucks to the next closest Starbucks.

## Solution

Use SimpleGeo's Places API to find the closest Starbucks to the user's current location and then once that location is set, make a second API call to SimpleGeo to find the next closest Starbucks location.

Then use the Google Maps API to give directions from the first Starbucks to the second Starbucks.

Add the SimpleGeo API to the collection of JavaScript libraries:

```
<script src="http://maps.google.com/maps/api/js?sensor=false"></script>
<script src="http://j.maxmind.com/app/geoip.js"></script>
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.4.4/jquery.js"></script>
<script src="http://cdn.simplegeo.com/js/1.2/simplegeo.places.jq.min.js"></script>
```

SimpleGeo is free but it does require you to sign up to get an API key (see <http://simplegeo.com/>).

Once you've signed up, find the API Key by clicking the Tokens menu and then the JSONP TOKENS sub menu as shown in [Figure 8-5](#).

Add your website domain(s) to the allowed domains list. This prevents other people from using your API Key. Now copy the Key and replace the placeholder at the top of our sample's JavaScript:

```
//simplegeo globals:
var geoclient = new simplegeo.PlacesClient('REPLACE WITH YOUR API KEY');

//google maps globals:
var directionRenderer;
```

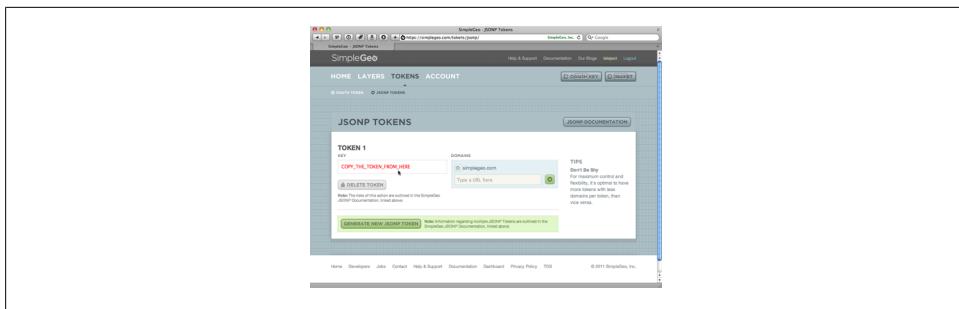


Figure 8-5. Simple Geo API Key.

```

var directionsService = new google.maps.DirectionsService();
var map;

$(document).ready(function () {

    /////setup map starting point for Google Maps
    //set initial coords to latitude -92 and longitude 32 which is somewhere around Kansas City in the
    // and then set the zoom to 4 so the entire US is visible and centered.
    var kansas = new google.maps.LatLng(32, -92);
    var myOptions = {
        zoom: 4,
        mapTypeId: google.maps.MapTypeId.ROADMAP,
        center: kansas
    }
    map = new google.maps.Map(document.getElementById("map"), myOptions);
    directionsRenderer = new google.maps.DirectionsRenderer();
    directionsRenderer.setMap(map);

    //wire up button click.
    $('#go').click(function () {
        //use our new getLatLng with fallback and define an inline function to handle the callback.
        getLatLng(function (latitude, longitude, isMaxMind) {
            //use simplegeo to get closest starbucks.
            var query = "Starbucks";
            geoclient.search(latitude, longitude, { q: query, radius: 20, num: 1 }, function (err, data)
                if (err) {
                    error(err);
                } else {
                    //we only asked for one result and SimpleGeo returns results based on distance so the
                    // so make sure we got a result.
                    if (dataStart.features.length == 1) {
                        //save start coordinates and address.
                        var startLat = dataStart.features[0].geometry.coordinates[1];
                        var startLng = dataStart.features[0].geometry.coordinates[0];
                        var startAddress = dataStart.features[0].properties['address'];
                        //save in google LatLng as well.
                        var start = new google.maps.LatLng(startLat, startLng);

                        //look up the closest Starbucks to the one we just found.
                        geoclient.search(startLat, startLng, { q: query, radius: 20, num: 2 }, function
                            if (err) {

```

```

        error(err);
    } else {
        //this time we asked for two results. The first result should be the start
        // so this time access the second result.
        if (dataEnd.features.length == 2) {
            //save end coordinates and address.
            var endLat = dataEnd.features[1].geometry.coordinates[1];
            var endLng = dataEnd.features[1].geometry.coordinates[0];
            var endAddress = dataEnd.features[1].properties['address'];
            //save in google LatLng as well.
            var end = new google.maps.LatLng(endLat, endLng);

            //now add directions from starting Starbucks to ending one.
            //set the request options:
            var request = {
                origin: start,
                destination: end,
                travelMode: google.maps.DirectionsTravelMode.DRIVING
            };

            //make the directions request.
            directionsService.route(request, function (result, status) {
                if (status == google.maps.DirectionsStatus.OK) {

                    //display the directions using Google's Directions Renderer
                    directionsRenderer.setDirections(result);

                    ////output info seperately.
                    $('#info').html('Closest Starbucks: <strong>' + startAddress +
                        'Next Starbucks: <strong>' + endAddress + '</strong>');

                    } else {
                        error("Directions failed due to: " + status);
                    }
                });
            } else {
                error('Could not find a Starbucks near ' + startAddress);
            }
        });
    }

    } else {
        error('Could not find a Starbucks near you.');
    }
});

//if we used MaxMind for location add attribution link.
if (isMaxMind) {
    $('body').append('<p><a href="http://www.maxmind.com" target="_blank">IP to Location Service</a></p>');
}

```

```

    });

});

function getLatLng(callback) {
    //test for presence of geolocation.
    if (navigator && navigator.geolocation) {
        //make the request for the user's position.
        navigator.geolocation.getCurrentPosition(function (position) {
            //success handler
            callback(position.coords.latitude, position.coords.longitude);
        },
        function (err) {
            //handle the error by passing the callback the location from MaxMind.
            callback(geoip_latitude(), geoip_longitude(), true);
        });
    } else {
        //geolocation not available so pass the callback the location from MaxMind.
        callback(geoip_latitude(), geoip_longitude(), true);
    }
}

function error(msg) {
    alert(msg);
}

```

## Discussion

Other than the call to `simplegeo.PlacesClient` to setup SimpleGeo, the code starts off the same as the previous example.

In the click handler, get the user's current location using the `getLatLng` function and use the resulting latitude and longitude to call the SimpleGeo `geoclient.search` function to find the closest Starbucks to us.

The `geoclient.search` function takes in latitude and longitude parameters, our query options, and a callback function.

Set the query options to a search term (`q` param) of `Starbucks` within a `20` kilometer radius (`radius` param), and indicate that only one result (`num` param) is required.

The callback returns a `features` collection, which contains various information including latitude and longitude about each search result.

In the callback save the latitude, longitude, and address in variables as our starting location.

Then make a second `geoclient.search` call using the starting location as the reference point. This time return two results, since the first result is still the starting location. Store the second `feature` item's latitude, longitude, and address in the ending location variables.

Now that the start and end locations are set, use the same Google Maps API call as the last example to display the driving directions between the two locations. To finish off the example, display the address of the starting and ending addresses above the map.

## See Also

Create dynamic maps with datasets with a free JavaScript library at <http://polymaps.org/>.



---

# CHAPTER 9

# Canvas

*Kyle Simpson*

## Introduction

One of the most exciting additions to web pages to be standardized by HTML5 is the **canvas** element:

```
<canvas id="mycanvas"></canvas>
```

This simple element allows users to draw graphics such as lines, circles, fills, etc. directly into a rectangle-shaped block element that appears on the web page.

There are numerous features associated with the **canvas** element.

For example, in addition to drawing images manually, browsers can take raw image data from an external image file and “draw” it onto the **canvas** element.

With the ability to draw an image comes the ability to erase and re-draw all or a portion of the **canvas** image. Editing canvas images then lends itself to the creation of animations where you appear to move elements around by drawing and re-drawing them in varying positions.

In addition, **canvas** elements can have transparency, which means they can be layered or stacked on top of each other to create more sophisticated graphical images/effects.

There are also a number of transformations and effects that you can apply to your **canvas** drawing.

In essence, **canvas** is a dynamic image and not simply a static PNG or JPEG file.

In much the same way that you might draw an image using a graphics program like Adobe Photoshop, save it to a file, and load it onto a web page, with **canvas** you can automate through code that the drawing commands, and immediately see the results on the page, without the need for loading an external file.

This capability allows you to do many sophisticated things that were once difficult or impossible to do, such as dynamically creating preview images.



While it is very helpful to understand the nuts and bolts of working with the `canvas` API, which this chapter will help expose you to, most practical projects use libraries that automate the usage of `canvas` for various tasks. As you will see, some of the tasks can be quite tedious, so using a helper library can be the key to keeping you productive and sane.

## Drawing on a canvas

### Problem

You want to draw graphic elements on your page rather than including them in as an external image with the `img` element.

### Solution

Use the `canvas` element in your markup:

```
<canvas id="mycanvas"></canvas>
```



The `canvas` element can have “fallback” content inside the tag, which the browser will only render if `canvas` itself is not supported.

While not a strong feature for Accessibility purposes, this does provide a modest mechanism for alternate content that screen readers can make available to the user. (For more on Accessibility, see [Chapter 7](#).)

Alternatively, you can always create a `canvas` element dynamically and append it to the page and then use CSS to position it where you need it:

```
var mycanvas = document.createElement("canvas");
mycanvas.id = "mycanvas";
document.body.appendChild(mycanvas);
```

To draw into the `canvas` element, first get a reference to the `canvas` element’s `context`, and then issue drawing commands against that reference, as shown in [Figure 9-1](#).

```
var mycanvas = document.getElementById("mycanvas");
var mycontext = mycanvas.getContext("2d");

mycontext.beginPath();
mycontext.moveTo(10, 10);
mycontext.lineTo(35, 35); // draws a line path from (10,10) to (35,35)

mycontext.strokeStyle = "#000";
mycontext.stroke(); // draw the line

mycontext.beginPath();
mycontext.arc(35, 35, 10, 0, Math.PI * 2, true); // draw a circle
```

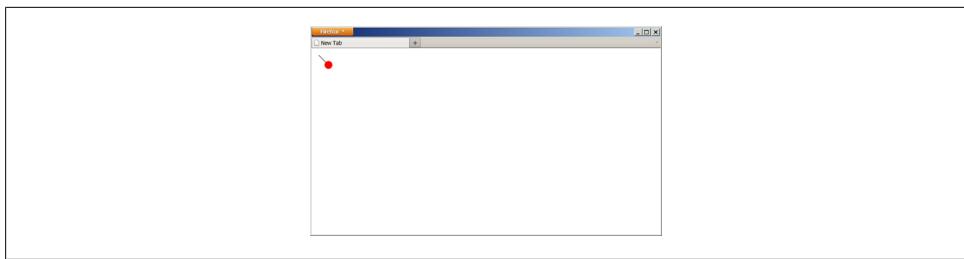


Figure 9-1. A canvas element on the page, with a black line and red circle drawn on it.

```
mycontext.fillStyle = "#foo";  
mycontext.fill(); // fill the circle solid
```



In `canvas`, the order of how you draw things is important—here we drew the line first and the circle second—as the last drawing operation for any pixel is the one that is visible.

## canvas API

Here are some commonly used drawing commands in the `canvas` API:

### `beginPath()`

Start a path segment definition, to be used by a rendering operation, like `stroke()` or `fill()`

### `closePath()`

Close the path by adding a line segment from the end of the path back to the beginning of the path

### `moveTo(x, y)`

Move the registration point for the next relative drawing operation

### `lineTo(x, y)`

Create a line path from the current registration point to (x,y)

### `rect(x, y, width, height)`

Create a rectangle path where (x,y) is one corner, and the diagonally opposite corner is (x+width,y+height)

### `arc(x, y, radius, startAngleRadians, endAngleRadians, antiClockwiseDirection)`

Create a circular arc path (up to a full circle), where (x,y) is the center of the arc, and the arc starts and ends at the given angles (in radians), and moves in either the clockwise or counter-clockwise direction

### `fill()`

Fill in the most recently defined path segment

### `stroke()`

Stroke (render, make visible) the most recent path segment

```
drawImage(image, ...)  
    Draw an image into the canvas area  
strokeText(text,...)  
fillText(text,...)  
    Add text to the canvas  
clearRect(x, y, width, height)  
    Clear a rectangular portion of the canvas from (x,y) to (x+width,y+height)  
strokeStyle=[string|object]  
fillStyle=[string|object]  
    Set the color/style attributes for strokes or fills, respectively
```

## Discussion

The `canvas` API for 2D drawing is standardized in HTML5 (see <http://dev.w3.org/html5/2dcontext/>).

In large part, `canvas` works the same way across all the modern browsers—which all now support it. However, be aware that there are some quirks that are different between browsers, in subtle ways.



Because these quirks in behavior between different browsers/versions are generally outside the specification, and more implementation specific, detailing or predicting such differences is futile.

As such, we do not cover those quirks in-depth, but instead the reader is implored to carefully test the usage of `canvas` and its API in all relevant browsers to catch such pitfalls.

The `canvas` element is specified to have a couple of *rendering contexts*, which is basically a fancy way of saying “coordinate system.”

At this time, the only useful or implemented rendering context is “2d”, which defines a flat two-dimensional Cartesian coordinate system with (0,0) at the top-left corner (thereby matching the coordinate system style in web pages). Practically all `canvas` API calls are made against the context, rather than the `canvas` itself.

Assuming you have a reference to a `canvas` element, to get a reference to its 2d context, use:

```
var mycontext = mycanvas.getContext("2d");
```

Once you have the context, the `canvas` API commands listed above are all available to be called. The shape drawing commands in the `canvas` API are all path based. This means that you first “draw”—or define, but *not* visibly—a path (one or more straight or curved edges) which represents the shape (line, arc/curve, rectangle, etc), and then you specify what you want done to the path.

Commonly, you either *stroke* the path—meaning, draw a line along the boundary edges of the path—and/or *fill* the path—which fills the interior of the path with a color or pattern.

Because you essentially render a path only after that path is defined, it is quite common that you end up needing to create many separate path segments in your drawing, where you apply different strokes/fills/etc. to render each segment as you define them.

So, always call `beginPath()` before you start defining a path segment:

```
mycontext.beginPath();
mycontext.moveTo(10, 10);
mycontext.lineTo(30, 30);
```



If you call `closePath()` before you call a rendering command like `stroke()` or `fill()`, the path literally is “closed”, in that the beginning point of the path is automatically joined with the end point of the path, with a final line segment.

After defining a path segment, call a rendering command, such as `stroke()` or `fill()`. Those commands act upon that most recently defined path segment—whatever has been defined since the most recent `beginPath()` call—and then subsequently that path is no longer active or available:

```
mycontext.beginPath();
mycontext.moveTo(10, 10);
mycontext.lineTo(30, 30);
mycontext.stroke();
```

Keep in mind that if you draw more than one shape in the same path segment, generally speaking the canvas interprets the paths as being connected.

In this sense, “connected” means that there is an edge from the end of one shape to the beginning of the next. This is not always true—some shape definition commands imply their own independent or not-relative segments.

Again, it’s best practice to explicitly define your path segments, to avoid such pitfalls. One explicit way to avoid segments being connected is to use `beginPath(...)`, which conceptually “picks up the pen” and moves it to a new location before setting it down, rather than acting like the pen drew a connection from the previous location to the new location.

## Vectors vs. Bitmaps

You may be familiar with the concept of *vector* drawing as opposed to *bitmap* drawing. Vector drawing is essentially describing an image as a series of shapes which are described by equations, such that the shapes (the vectors) can be modified (rotated, scaled, transformed, etc) without any loss of quality.

Bitmap drawing, on the other hand, is specifically constrained to painting a color into one or more individual pixel locations. Transformations against bitmaps are “lossy” in that you get some fuzzy or blurry artifacts along color boundaries as you make the transformations, because what might have been a clear color boundary from one pixel to the adjacent pixel in the original orientation of the drawing is now not a clear boundary between two pixels, but a mix of colors between the two pixels.

It is important to keep vector and bitmap ideas clear and separate in your mind as you work with the `canvas` element. The paths that you draw with API commands like `lineTo(...)` are like vectors. They can be defined and then modified using various transformations, without any loss of quality. Once you have the path in the correct state that you want, you then render that path, which creates visible pixels in the bitmap output of your `canvas` element. If you were to then apply more transformations to your bitmap, such as rotating the entire element, you would be subject to potentially “lossy” transformations, as described above.

To put it more plainly, think of your path definitions as vector equations—which are invisible, and until rendered, can be changed at will—and think of the stroke and fill operations that you perform against a path as pixel bitmap rendering. In principle, this is no different than how a vector image editor program would operate.



If you draw a shape (or modify a shape’s location or dimensions) where it overlaps only part of a pixel, such as a line from (10.5,20) to (10.5,50), then each half pixel is partially rendered (anti-aliasing), which may produce fuzzy line effects.

There are of course operations that you explicitly *want* to perform only against the final rendered output (such as color mutations), but these operations are bitmap based, as opposed to the geometric transformations you perform against paths.

## See Also

For more information on how to use canvas, see this canvas tutorial on MDC: [https://developer.mozilla.org/en/Canvas\\_tutorial](https://developer.mozilla.org/en/Canvas_tutorial).

# Using Transparency

## Problem

You want to leave part of the `canvas` element transparent to show through content from beneath.

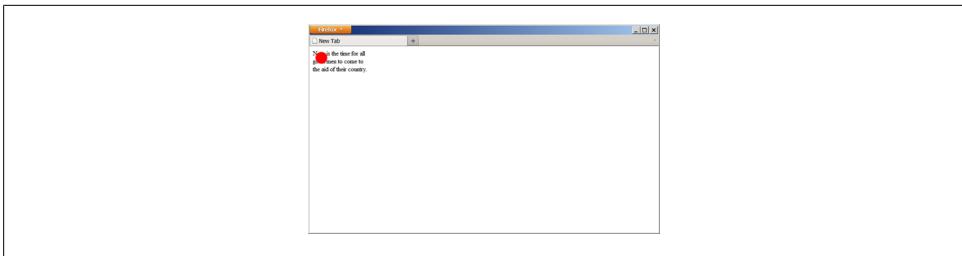


Figure 9-2. Drawing a circle on top of text in a page, with transparency showing the not-covered text from beneath.

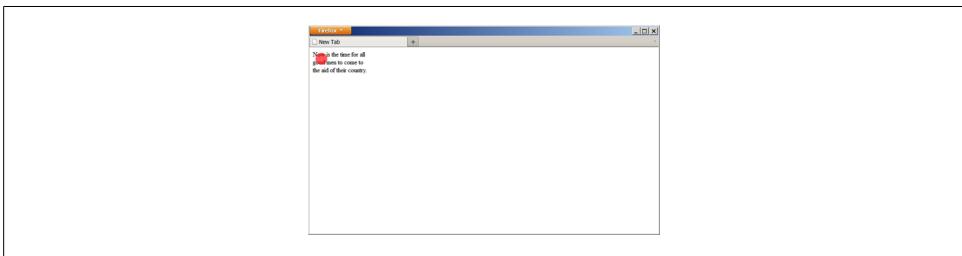


Figure 9-3. Partial transparency of the red circle showing through text from underneath.

## Solution

The `canvas` element is, by default, transparent, which means that it will show through any content that is stacked beneath it. This means that you can control what pixels are transparent or not simply by what you draw onto the `canvas` element.

If we position a red circle drawing (like from the previous recipe) over the top of some text, the portions of the `canvas` element not drawn on by the circle are transparent, showing the text from beneath, as shown in [Figure 9-2](#).

In addition to the transparency of any pixel that has not yet been drawn into on the `canvas` element, a pixel can have partial transparency using the alpha channel of the color used to draw the pixel. Partial transparency means that what the user sees for each pixel is the combination of what color is at that location below the `canvas` element, combined with the partial color shown for that pixel in the `canvas` element.

If the red circle over the page text from above were drawn with partially transparent color, it would appear as shown in [Figure 9-3](#).

The partially transparent color is not only useful for content that appears on the page beneath the `canvas` element, but also for content that is already drawn onto the `canvas` element itself:

```
mycontext.beginPath();
mycontext.arc(40, 40, 25, 0, Math.PI * 2, true); // draw a circle
mycontext.closePath();
```

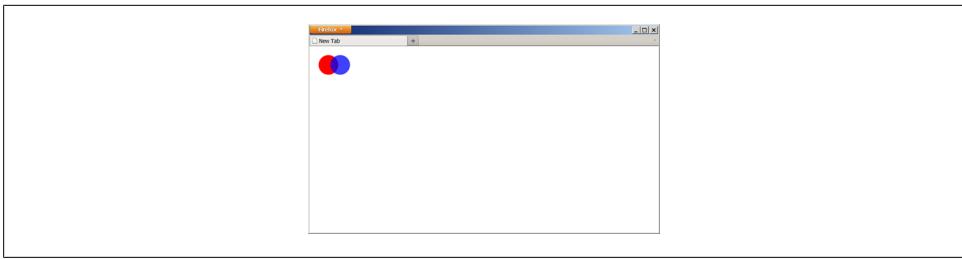


Figure 9-4. Applying partial transparency to the blue color circle, mixing with the red circle in the overlap.

```
mycontext.fillStyle = "#foo";
mycontext.fill(); // fill the circle solid

mycontext.beginPath();
mycontext.arc(70, 40, 25, 0, Math.PI * 2, true); // draw a circle
mycontext.closePath();

mycontext.fillStyle = "rgba(0,0,255,0.75)";
mycontext.fill(); // fill the circle solid;
```

In the above code snippet, we draw a partially transparent blue circle overlapping part of a red circle. The portion of the circles that overlap will produce the color purple from the mixing of the blue with the red, as seen in [Figure 9-4](#).

## Discussion

In general, a `canvas` element starts out with all pixels being completely transparent. Any pixel which is drawn with a fully opaque color will no longer have any transparency, whereas any pixel that is drawn with a partially opaque color will retain partial transparency.

When you render shapes as pixels into the bitmap of the 2d context, each pixel can also have a definition of how opaque or transparent that pixel should be rendered (default is fully opaque with no transparency). You define the transparency (alpha) of a color generally with “`rgba`”, which is specified as identical to CSS3 color values (<http://www.w3.org/TR/2003/CR-css3-color-20030514/#numerical>), like so:

```
mycontext.fillStyle = "rgba(255,0,0,0.5);
```

In that code snippet, the “`0.5`” specifies a 50% opacity for the red color, meaning all pixels that are drawn with that color style have only 50% opacity, and thus 50% transparency to show through from beneath as shown in [Figure 9-5](#).

The other way to affect the transparency of rendered pixels is to set the `globalAlpha` property, with a value from 0.0 to 1.0. When a pixel is drawn where it has some transparency to its color, the default composite operation is to take that pixel’s existing rendered color definition, if any, and combine it with this new color definition, to

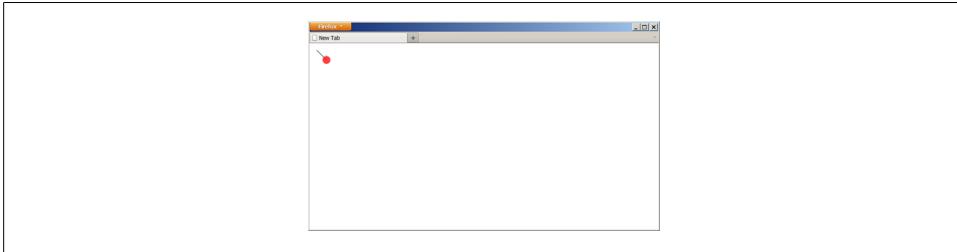


Figure 9-5. Applying 50% transparency to the color used to fill the red circle, partially revealing the prior drawn black line below it.

produce the new pixel color. That's how the black line appears to be below the partially transparent red dot.

Keep in mind, though, there's not two actual layers of shapes here (as you might be used to with digital imaging software), even though it appears that way. The pixels that were rendered were composited together, combining what was already there in the first path with what's drawn by the second path. The final result is still one single-layer bitmap rendering in your `canvas` element. This means that once these two shapes have been rendered on top of each other, they cannot be moved or changed independently, since there's just one bitmap.

However, since pixels in a `canvas` element can have transparency, it is possible to emulate separate layers by simply having more than one `canvas` element, each stacked on top of each other, and drawing different shapes into the different respective `canvas` elements. In this case, there is not really `canvas`-level compositing going on between the two independent layers (separate elements, although obviously your browser, operating system, and computer screen are doing the compositing), so the two elements can be moved, modified, erased, etc, independently of each other. (See “[Animating canvas Drawings](#)” on page 193 for more detail.)

## See Also

For more information on transparency, see this canvas “styles and colors” tutorial on MDC: [https://developer.mozilla.org/En/Canvas\\_tutorial/Applying\\_styles\\_and\\_colors](https://developer.mozilla.org/En/Canvas_tutorial/Applying_styles_and_colors).

## Setting canvas Dimensions

### Problem

You want to explicitly specify the width and height of your `canvas` element to be different than the default dimensions.

## Solution

Add the `width` and `height` attributes, and their corresponding values, to your `canvas` element:

```
<canvas id="mycanvas" width="200" height="200"></canvas>
```

You may also want to change `width` and/or `height` of your `canvas` element with JavaScript. If you want to change how much width or height (pixels for rendering) is available in your `canvas` element, then you must change the *attributes* of the `canvas` element (not the CSS style properties of `width` and `height`, as you might assume):

```
mycanvas.setAttribute("width", "200"); // will change the bitmap dimensions  
mycanvas.setAttribute("height", "200");
```

You can also set the `width` and `height` properties directly on the element:

```
mycanvas.width = 200; // will change the bitmap dimensions  
mycanvas.height = 200;
```

Either approach will allow your `canvas` element to use 200 pixels in the horizontal direction, and 200 pixels in the vertical direction.

By contrast, controlling the size of your `canvas` element with CSS—either with CSS rules or by directly setting CSS properties in JavaScript—does not affect the bitmap dimensions of your `canvas` element, but takes the existing `canvas` element (at its existing bitmap dimensions) and stretch or shrink its physical dimensions, as necessary:

```
mycanvas.style.width = "200px"; // will shrink the horizontal rendering  
mycanvas.style.height = "200px"; // will stretch the vertical rendering
```

## Discussion

By specification, the default dimensions of a `canvas` element are 300 pixels by 150 pixels. In practice, you'll usually want to define a different dimension for your `canvas` element.



As with all block-level HTML elements, if you make your `<canvas>` absolutely positioned, it does not necessarily default to having any physical dimensions to render. You need to explicitly define the physical rendering dimensions via CSS, in addition to the bitmap pixel dimensions. To keep a consistent rendering ratio, make sure the physical dimensions match the bitmap pixel dimensions.

You can specify the bitmap pixel dimensions using attributes on the `canvas` element, either in the markup or with a `setAttribute(...)` call. You can also resize the `canvas` element by using CSS styling on the `width/height`, but this has the effect of shrinking or stretching the `canvas` element while keeping the existing pixel dimensions, rather than actually changing them.

For instance, let's say you wanted a full-page `canvas` element that resized itself with the window. If you want that sizing to be stretching or shrinking the `canvas` element while maintaining the same pixel dimensions, then use CSS, like this:

```
#mycanvas { width:100%; height:100%; }
```

However, if you want a `canvas` element that keeps resizing its bitmap pixel dimensions along with the dimensions of the browser window, you need to use JavaScript:

```
window.onresize = function() {
    mycanvas.width = document.documentElement.clientWidth;
    mycanvas.height = document.documentElement.clientHeight;
};
```

The `canvas` element can be resized as often as you like. However, each time you resize it, the drawing space will be cleared. This is actually a useful trick, which you can use to quickly clear the `canvas`, by simply setting its width to be the same as its current width:

```
function clear(mycanvas) {
    mycanvas.width = mycanvas.width;
}
```

## Creating a Gradient

### Problem

You want to create gradients and other drawing styles.

### Solution

Each time you render a path to the `canvas` element, the color and style for that drawing are picked up from the currently set stroke and fill styles.

For instance, to vary the way that line segments are drawn on paths, you can control the stroke styles with `lineWidth`, `lineCap`, and `lineJoin`, as shown in [Figure 9-6](#).

```
mycontext.lineWidth = "12";
mycontext.lineJoin = "round";
mycontext.moveTo(20, 20);
mycontext.lineTo(50, 50);
mycontext.lineTo(20, 70);
mycontext.stroke();
```

To vary what is painted inside the paths you draw, you can control the fill styles to create gradients or image patterns, as shown in [Figure 9-7](#).

```
var lingrad = mycontext.createLinearGradient(20,20,40,60);
lingrad.addColorStop(0.3, "#0f0");
lingrad.addColorStop(1, "#fff");
mycontext.fillStyle = lingrad;
```

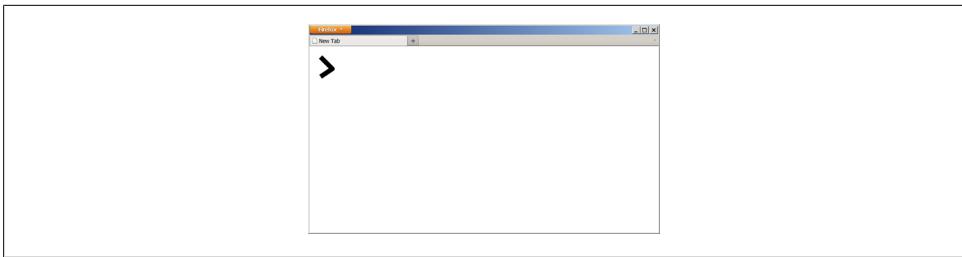


Figure 9-6. `lineWidth` and `lineJoin` stroke styles.

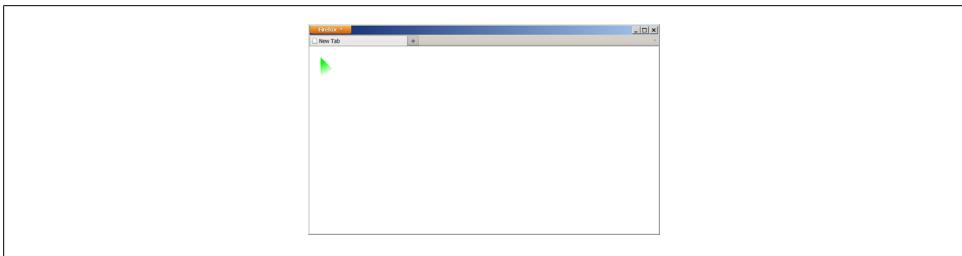


Figure 9-7. Linear gradient filling a shape.

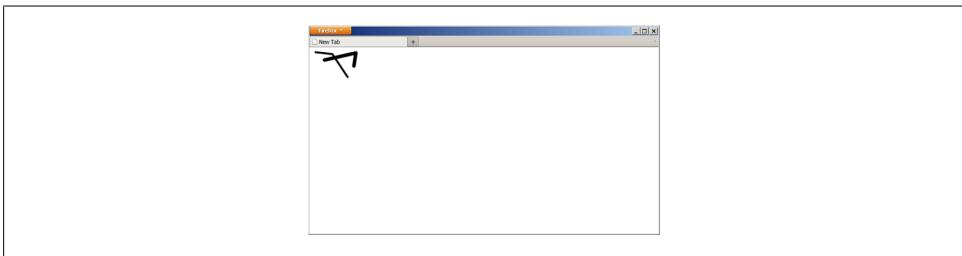


Figure 9-8. Various line styles.

```
mycontext.moveTo(20, 20);
mycontext.lineTo(50, 50);
mycontext.lineTo(20, 70);
mycontext.closePath();
mycontext.fill();
```

## Discussion

There are several different ways to control the style of how your paths are rendered. For instance, for lines (strokes), you can set the `lineWidth` property to vary the width of lines used to stroke. In addition, the `lineCap` property controls how the cap/end of a line segment is rendered (squared off, rounded, etc), and the `lineJoin` property controls how the connection (or joint) between two line segments is drawn. [Figure 9-8](#) shows a few different line styles.

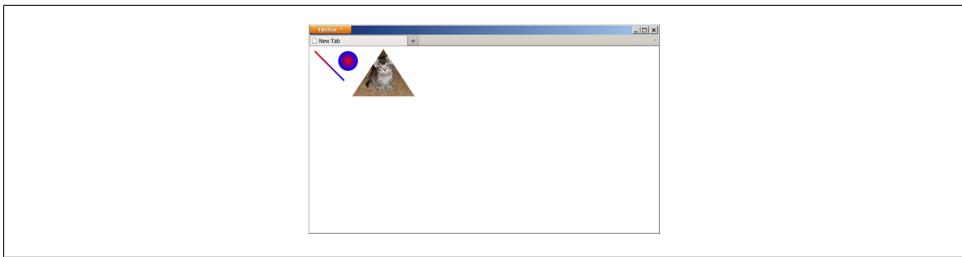


Figure 9-9. Various fill gradients and patterns.

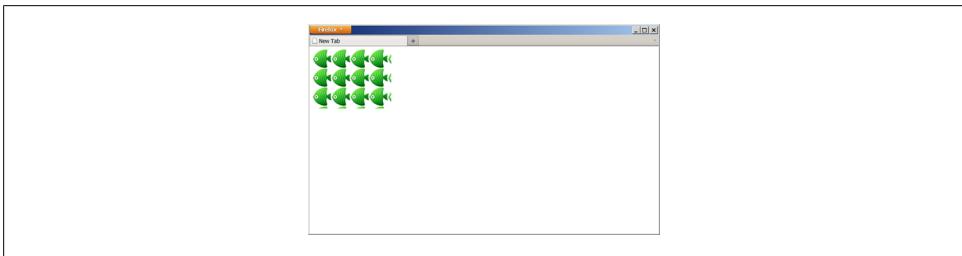


Figure 9-10. Tiling an image using a fill pattern.

In addition to line styles, you can define custom color styles for both lines and fills. There are two options: gradients and patterns.

Gradients are a gradual progression from one color to another color (or colors). They can be linear (progresses in a straight line) or radial (progresses radially/circularly from a central point). To use them, you create a gradient object, next set one or more *color stops* on it, and then use that object as the `strokeStyle` or `fillStyle`.

Patterns are essentially taking an existing image (even another `canvas` element) and using that as the “color” for a line or fill, where the image in question is repeated as necessary to fill the space required of the color. To use them, you create a pattern object, telling it which image to use and how to repeat, and then use that object as the `strokeStyle` or `fillStyle`. [Figure 9-9](#) shows the results of a few different fill gradients and patterns.

Pattern fills also allow you to tile (or repeat) an image. The `canvas` API command `createPattern(...)` takes as its second parameter a string value to control the tiling. For no tiling, use “no-repeat.” Currently, the only tiling value supported consistently is “repeat”, which defaults to repeating the image both horizontally and vertically, as shown in [Figure 9-10](#).

```
var img = document.getElementById("my_fish_image");
var imgfill = mycontext.createPattern(img, "repeat");
mycontext.fillStyle = imgfill;
mycontext.fillRect(0, 0, 200, 200);
```

## See Also

For more information on line styles, gradients, and pattern fills, see this canvas “styles and colors” tutorial on MDC: [https://developer.mozilla.org/En/Canvas\\_tutorial/Applying\\_styles\\_and\\_colors](https://developer.mozilla.org/En/Canvas_tutorial/Applying_styles_and_colors).

# Pulling External Images Into a canvas Drawing

## Problem

You have an existing image (graphic, icon, photo, etc.) in an external file that you want to put into a `canvas` element, so that you can then manipulate or embellish it with `canvas` API drawing commands.

## Solution

First, load the image in question using either an `img` tag in your markup, and get a reference to it, or create an `Image` element dynamically in your JavaScript code:

```
var img = new Image();
img.src = "http://somewhere/to/my/image.jpg";
```

Next, once the image is loaded, draw the image onto a `canvas` element:

```
var img = new Image();
img.onload = function() {
    // note: we're calling against the "2d" context here
    mycontext.drawImage(img, 0, 0); // draw the image at (0,0)
};
img.src = "http://somewhere/to/my/image.jpg";
```



The `image` object you pass as the first parameter to `drawImage(...)` can actually be a real image, another element, or a `video` element by capturing a frame of video into your `canvas`.

This assumes that your `canvas` element is already properly sized to be able to handle the image that you’re trying to draw into it. Otherwise, if it’s too small (in either dimension), *clipping* occurs, where the image will be cut off on the right or bottom edge, respectively.

## Discussion

The `canvas` API gives you the `drawImage(...)` command to let you capture image bitmap data from another source (an image, another `canvas` element, or a `video` element) and draw it directly into your `canvas` element.

`drawImage(...)` has three different ways it can be called. The simplest form, shown above, takes an element to capture the bitmap image data from, and two coordinates, the (X,Y) location inside your `canvas` element to start the top-left corner of the image at.

The second form takes an additional two parameters (dw,dh), which are the width and height of the area from the original image that you want to capture and copy to your `canvas` element.

Lastly, the third form of the call takes quite a few more parameters than the second form, where the first four numeric parameters (sx,sy,sw,sh) are the top-left location and width/height from the original source image data to capture, and the last four parameters (dx,dy,dw,dh) represent the top-left location and width/height of where the image data is copied to in your `canvas` element, as shown in [Figure 9-11](#).

```
function createCanvas(id, width, height) {
  var canvas = document.createElement("canvas");
  canvas.id = id;
  canvas.setAttribute("width", width);
  canvas.setAttribute("height", height);
  document.body.appendChild(canvas);
  return canvas;
}

var small_canvas = createCanvas("small", 100, 100);
var large_canvas = createCanvas("large", 300, 300);
var small_context = small_canvas.getContext("2d");
var large_context = large_canvas.getContext("2d");

var img = new Image();
img.onload = function() {
  // note: using different (sw,sh) and (dw,dh) dimensions here shrinks the image
  small_context.drawImage(img, 0, 0, 300, 300, 0, 0, 100, 100);
  // just grab the top-left 300x300 area from the image
  large_context.drawImage(img, 0, 0, 300, 300);
};
img.src = "http://somewhere/to/my/image.jpg";
```

Once you've drawn an image into your element, that image data is no different from any other bitmap image data that you could draw. This means that you can easily draw over the top of your drawn image, using all the same capabilities as previously discussed.

## Setting Color Transformations

### Problem

You have an existing `canvas` drawing that you want to apply a color transformation (like grayscale or invert) to.

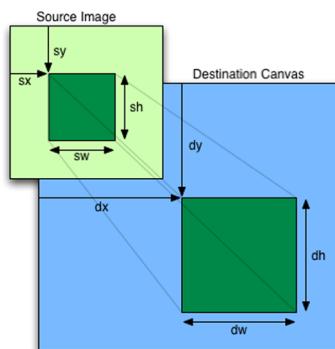


Figure 9-11. Explaining the  $(dx,dy,dw,dh)$  and  $(sx,sy,sw,sh)$  parameters of `drawImage(...)`.

## Solution

The `canvas` API provides a command `getImageData(...)`, which grabs all the pixel color data from the `canvas` element, handing it to you in one long array:

```
var drawing = mycontext.getImageData(0, 0, 200, 200);
```



The array you get from `getImageData(...)` is not in quite the format you'd generally expect. Firstly, it's not a two-dimensional array, with width and height dimensions. Instead, it is a linear single-dimension array, where the values wrap from one line to the next, like a big long string of text that you paste into a text editor.

Secondly, there are four consecutive entries in the array for each pixel, each entry corresponding to a color component for a pixel. So, each pixel takes up four entries in the array, in the form of [..., red, green, blue, alpha, ...].

Once you have the image data captured, you can manipulate that data using any transformations you please, and then write that image data back to the `canvas` element.

To grayscale the drawing, the simplest algorithm is to take the average of the red, green, and blue color components, and set all 3 to that average value:

```
var avg;
// skip 4 entries (1 px) at a time
for (var i = 0; i < drawing.data.length; i = i + 4) {
    avg = (drawing.data[i] + drawing.data[i+1] + drawing.data[i+2]) / 3;
    drawing.data[i] = drawing.data[i+1] = drawing.data[i+2] = avg;
}
```

To color invert the drawing, the simplest algorithm is to take each color component value, subtract it from 255, and set that color value back:

```
// skip 4 entries (1 px) at a time
for (var i = 0; i < drawing.data.length; i = i + 4) {
    drawing.data[i] = 255 - drawing.data[i]; // invert red
    drawing.data[i+1] = 255 - drawing.data[i+1]; // invert green
    drawing.data[i+2] = 255 - drawing.data[i+2]; // invert blue
}
```

Now that the data has been modified, we simply write the data back to the `canvas` element, using the `putImageData(...)` command:

```
mycontext.putImageData(drawing, 0, 0); // put the image data back at (0,0)
```

## Discussion

As we discussed in a previous recipe in this chapter, the image that is rendered visible on the page is the bitmap data rendering of the paths and styles (or vectors) that you defined while drawing your image.

Fortunately, the `canvas` element allows us to access and modify some or all of the pixel color data in the element. This means that any manner of sophisticated bitmap transformations can be accomplished.

Not only can you apply color transformations, as we did here, you could also apply algorithms to blur the image, pixelate it, zoom it, etc. Those various algorithms are beyond the scope of this chapter and book, but the process would always be the same as in this recipe: first get the bitmap image data array, process the individual color components (red, green, blue, alpha) entries for each pixel, then write some or all of that data back to your `canvas` element.



If you write an external image to a `<canvas>` element that comes from a different domain than the page's domain, the `<canvas>` is marked as "unclean" (meaning it's not abiding by the Same-origin security policy), and thus you are not able to call `getImageData(...)` to retrieve that data.

You can always write to the `<canvas>` element, but you can only read data from it if **all** the data in the `<canvas>` originated from the page's domain.

## See Also

This recipe only briefly touched on basic ways to manipulate the colors in your `canvas` images and drawings. For much more complex effects that you can apply to your `canvas` element, check out PaintbrushJS: <http://mezzoblue.github.com/PaintbrushJS/demo/>.

# Working with Geometric Transformations

## Problem

You want to apply some transformations to your drawing commands, such as scaling, rotation, skewing, etc.

## Solution

The `canvas` API provides several commands for transforming your `canvas` drawing actions:

`translate(x, y)`

Move/skew the location of the origin point for the coordinate system from (0,0) to (x,y)

`scale(x, y)`

Scales the units of the coordinate system in the x and y directions, independently

`rotate(angle)`

Rotate the coordinate system, about the origin point (0,0), the angle (clockwise direction) as specified in radians

When you start combining multiple transformations, it is often easier to manage the state of the `canvas` element on a stack, where you can simply revert back one level to undo all transformations (and other state, like style/color settings) with one command. The `canvas` API provides two commands for managing your state stack: `save()` and `restore()`:

```
mycontext.save(); // save the current state of the canvas  
mycontext.translate(10, 10); // move the origin point to (10,10)  
mycontext.arc(0, 0, 10, 0, Math.PI * 2, true); // draw a circle  
mycontext.stroke();  
mycontext.restore();  
  
mycontext.save();  
mycontext.rotate(Math.PI / 4); // rotate 45 degrees clockwise  
mycontext.moveTo(0, 0);  
mycontext.lineTo(10, 0);  
mycontext.stroke();  
mycontext.restore();
```

In both these transformations, the simple nature of the transformation could have been inversed. We could have easily translated back to our original origin point with `translate(-10, -10)`, or back to our original rotation with `rotate(Math.PI / -2)`.

However, as soon as you combine multiple translations at once, or if you start nesting translations into multiple steps or layers, then stack management becomes quite necessary. It is best practice to always use stack management for your `canvas` element's state as you make style changes or transformations.

## Discussion

The concept of using transformations to adjust your drawing commands is probably going to be a bit strange to you at first. Most developers are initially a little confused by this concept. Don't worry, after you do it a few times, you'll get more comfortable with this new mindset, and it won't seem quite so foreign.

To get started, here's what you need to know: transformations do not actually affect your drawing commands or what's currently in the `canvas` element. Instead, transformations affect the coordinate system, so that all the coordinates that you use in your subsequent drawing commands are automatically interpreted in the transformed coordinate system, instead of the original coordinate system.

Say what?! Ok, let's try a different approach: think of these transformations as keeping your pen in the same location, but (without the pen touching the paper) moving the paper underneath your pen to a different location or rotated at an angle, drawing what you planned as if the paper hadn't moved, and then moving the paper back to a normal position on the desk.

If you translate (or move) the coordinate system 10 pixels to the right, and you draw a shape at (0,0) relative to the now-moved coordinate system, the shape actually appears at (10,0) in the absolute coordinates *relative* to your `canvas` element container.

So, translating the coordinate system 10 pixels to the right, and drawing a shape at (0,0) is basically the same thing as not translating the coordinate system at all, and simply drawing the shape at (10,0):

```
mycontext.save();
mycontext.translate(10, 0); // move coordinate system 10 pixels right
mycontext.moveTo(0, 0);
mycontext.lineTo(50, 0); // line actually appears from (10,0) to (60,0)
mycontext.stroke();
mycontext.restore();

mycontext.moveTo(10, 0);
mycontext.lineTo(60, 0); // same line, basically
mycontext.stroke();
```

The same goes for rotation, although the math is a little trickier. If you rotate the canvas by 30 degrees clockwise, and draw a shape at (50,0), it's actually drawn at a relative location that appears to be ():

```
mycontext.save();
mycontext.rotate(Math.PI / 6); // rotate 30 degrees clockwise
mycontext.moveTo(0, 0);
mycontext.lineTo(50, 0); // line actually angles 30 degrees down from horizontal
mycontext.stroke();
mycontext.restore();
```

At first, you may wonder why translations and rotations are even necessary transformations. After all, can't you just draw your line or circle at the proper location and in the proper orientation, and not worry about complexity of the transformations?

For some tasks, yes. But again, for more complicated tasks, it's almost imperative that you transform your coordinate system so that your use of the drawing commands (and, in particular, which numbers you use for the parameters) is more sensible and semantic.

How would you draw a rectangle at an angle? Well, you could calculate the vertices using geometric calculations, and then manually draw the four sides as individual lines. But who wants to do it that way!? Instead, rotate the coordinate system and call the `rect(...)` command; simple as that.

Scaling is another example of something that almost always requires transformations to work properly, specifically because scaling can be done independently in both the X and Y directions. What scaling amounts to is saying that if you scale the X direction of your coordinate system to twice as large, and you draw a line that is supposed to be 50 units (pixels) long, it actually is rendered as twice as long (100 pixels):

```
mycontext.save();
mycontext.scale(2, 1); // scale X direction units by a factor of 2
mycontext.moveTo(0, 0);
mycontext.lineTo(50, 0); // line actually appears to extend to (100,0)
mycontext.stroke();
mycontext.restore();

mycontext.moveTo(0, 0);
mycontext.lineTo(100, 0); // same line, basically
mycontext.stroke();
```

Other tasks—rotating an image, for instance—beg for transformations, because it would be very difficult (and certainly performance-wise, impractical) to manually transform the raw bitmap image data array yourself. Instead, you simply rotate the coordinate system, draw the image into it, and then the `canvas` element does the hard work for you.

```
mycontext.save();
mycontext.rotate(Math.PI / 4); // 45 degrees clockwise
mycontext.drawImage(img, 0, 0); // draw the image at (0,0)
                           // in the rotated coordinate system
mycontext.restore();
```

Finally, let's take a look at nesting transformations, to reinforce why transformations and stack management of the `canvas` element's state are helpful (as shown in [Figure 9-12](#)).

```
mycontext.beginPath();
mycontext.strokeStyle = "#foo"; // red color
mycontext.translate(20, 20); // move the coordinate system to (20,20) origin
mycontext.moveTo(0, 0); // actually (20,20)
mycontext.lineTo(80, 10); // actually (100,30)
mycontext.stroke();

mycontext.save(); // save <canvas> state

mycontext.beginPath();
mycontext.strokeStyle = "#00f"; // now blue color
```

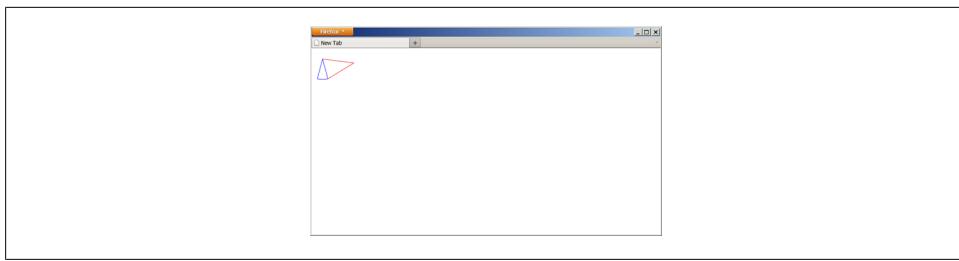


Figure 9-12. Coordinate system transformations and the stack management of the canvas state.

```
mycontext.rotate(Math.PI / 4);
mycontext.moveTo(0, 0);
mycontext.arc(0, 0, 52, Math.PI / 3, Math.PI / 6, true);
mycontext.closePath(); // connects back to the start of the path
mycontext.stroke();

mycontext.restore(); // back to previous <canvas> state

mycontext.beginPath();
mycontext.moveTo(80, 10);
mycontext.lineTo(14, 50);
mycontext.stroke();
```

## Placing Text on canvas

### Problem

You want to include text directly in your `canvas` drawing.

### Solution

The `canvas` API provides two commands for rendering text in your drawing: `fillText(...)` and `strokeText(...)`. Both commands take the same parameters: (`stringToRender`, `x`, `y`, [optional: `maxWidth`]). The only difference is whether the text is filled in, or simply outlined.

To set the font style (font-face, size, etc), use the `font` property:

```
mycontext.font = "25pt Arial";
```

Now, simply call the appropriate text command (as shown in [Figure 9-13](#)):

```
mycontext.fillText("Hello World", 0, 25);
mycontext.strokeText("Hello World", 0, 75);
```

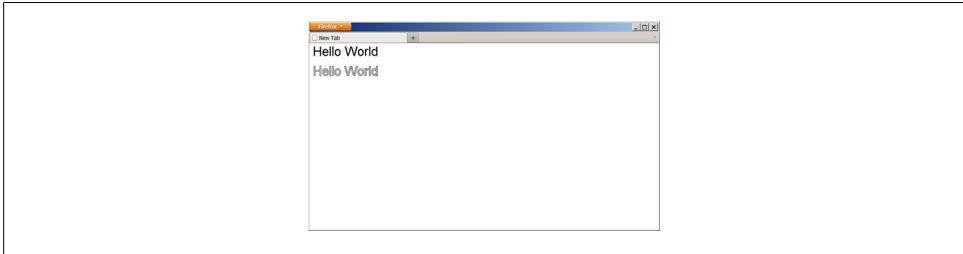


Figure 9-13. Filled and stroked text.

## Discussion

The `fillText(...)` and `strokeText(...)` commands use the font styling specified in the `font` property. The available font-face, style, size, etc settings are defined to be the same as what would be available to CSS font style rules. The colors used are of course controlled by the `fillStyle` and `strokeStyle` properties, respectively. The same goes for the stroke line width.

## See Also

Drawing text on a canvas at [https://developer.mozilla.org/en/drawing\\_text\\_using\\_a\\_canvas](https://developer.mozilla.org/en/drawing_text_using_a_canvas).

# Clipping canvas Drawings

## Problem

You want to use a drawing command (like text) but you want to clip the drawing by some other shape that you define.

## Solution

The `canvas` API provides the command `clip(...)`, which will take the currently defined path and use that as a *clipping mask* for subsequent drawing commands. This means the `canvas` element will only draw inside the defined clipping mask boundaries, and discard any drawing outside the path.

To add the text of the letter “H”, but clip it by a circle, you would do this:

```
mycontext.beginPath();
mycontext.arc(50, 50, 25, 0, Math.PI * 2, true); // circle path
mycontext.clip(); // make the path our clipping mask

mycontext.fillStyle = "#foo";
```

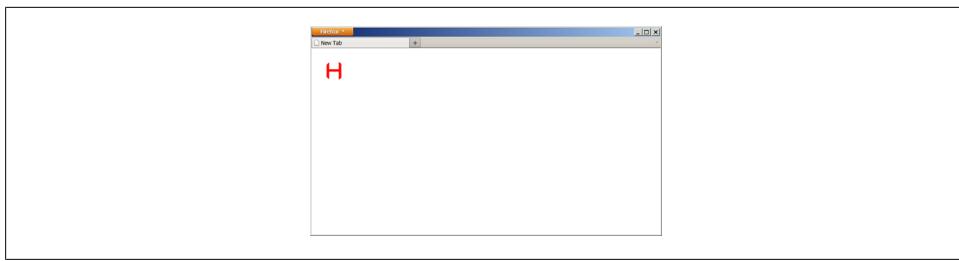


Figure 9-14. Clipping a text command with a circle path.

```
mycontext.font = "50pt Arial";
mycontext.fillText("H", 25, 75);
```

The result of the circle-clipped “H” is shown in [Figure 9-14](#).

As you can see, the circle itself was not drawn; instead it was used as the clipping path for the subsequent `fillText` drawing command.

## Discussion

The `canvas` element’s state defaults to a clipping mask that comprises the entire visible area of the `canvas` element. Once you define a clipping mask using the `clip(...)` command, that clipping mask will remain in effect for all future drawing commands, until you change or reset it.

Just as we saw in [“Working with Geometric Transformations” on page 188](#), you can use stack management of the element’s state to make a temporary clipping mask change, and then roll it back to the default (entire element) as shown in [Figure 9-15](#).

```
mycontext.save();
mycontext.beginPath();
mycontext.arc(50, 50, 25, 0, Math.PI * 2, true); // circle path
mycontext.clip(); // make the path our clipping mask

mycontext.fillStyle = "#foo";
mycontext.font = "50pt Arial";
mycontext.fillText("H", 25, 75);
mycontext.restore(); // back to default canvas state (including clipping)

mycontext.font = "25pt Arial";
mycontext.fillText("ello World", 70, 70); // black text, not clipped
```

# Animating canvas Drawings

## Problem

Drawing static shapes into the `canvas` element is fine, but now you want to make the shapes move around.

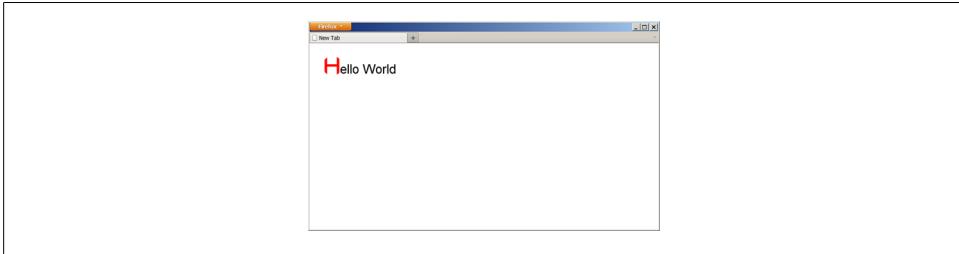


Figure 9-15. Rolling back to previous clipping mask state.

## Solution

Animation with the `canvas` element boils down to drawing a frame of your animation, then a few milliseconds later, erasing that drawing and re-drawing the next frame, probably with some elements slightly moved or otherwise changed. If you animate by showing the frames fast enough—around 20-30 frames per second—it generally looks like a smooth animation of your shapes.

In this chapter, we've already covered how to draw various things into your `canvas` element. We also briefly mentioned one way to clear your `canvas` element (resetting the width). To fire up some animation, all we need to do is put those two concepts together.

Here's a basic example of a moving red dot (which is shown in Figure 9-16):

```
function draw_circle(x, y) {
    mycontext.fillStyle = "#foo";
    mycontext.beginPath();
    mycontext.arc(x, y, 10, 0, Math.PI * 2, true);
    mycontext.fill();
}

function erase_frame() {
    mycanvas.width = mycanvas.width;
}

var ball_x = 50;
var ball_y = 50;
var delta = 3;

draw_circle(ball_x, ball_y);

setInterval(function(){
    if (ball_x > 100 || ball_y < 15 || ball_x < 15 || ball_y > 100) {
        delta *= -1;
    }
    ball_x += delta;
    ball_y += delta;
    erase_frame();
    draw_circle(ball_x, ball_y);
}, 35);
```

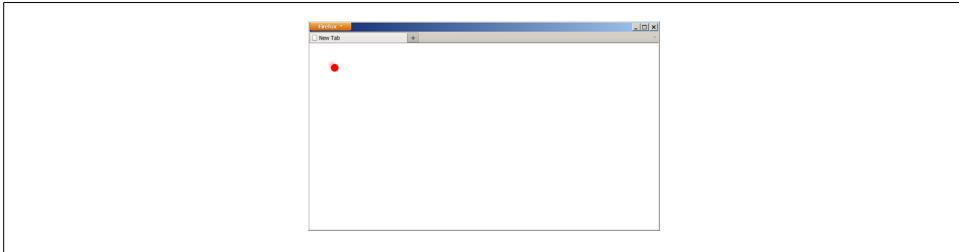


Figure 9-16. Animating a red circle in the canvas.

## Discussion

Depending on the setup of your animation frame, you may need to employ various different methods to get the most efficient drawing (and erasing) of your shapes and/or images. We'll now cover several different approaches to drawing and erasing to accomplish animations with the `canvas` element.

First, as in the example code above, if you have a transparent background, and one shape (like a circle) bouncing around, to erase the frame before drawing the next frame, you don't need to erase the whole `canvas` element—only a small portion of the element has anything drawn in it (the circle) at any given time.

All you need to do is erase the part of the `canvas` element that you drew onto in the previous frame. Especially for larger dimensions, this technique can be significantly better for performance.

The way to do that is to use the `canvas` API command `clearRect(...)` to erase only part of the `canvas` element:

```
function draw_circle(x, y) {
    mycontext.fillStyle = "#foo";
    mycontext.beginPath();
    mycontext.arc(x, y, 10, 0, Math.PI * 2, true);
    mycontext.fill();
}

function erase_circle(x, y) {
    mycontext.clearRect(x-10, y-10, 20, 20);
}

var ball_x = 50;
var ball_y = 50;
var delta = 3;

draw_circle(ball_x, ball_y);

setInterval(function(){
    if (ball_x > 100 || ball_y < 15 || ball_x < 15 || ball_y > 100) {
        delta *= -1;
    }
})
```

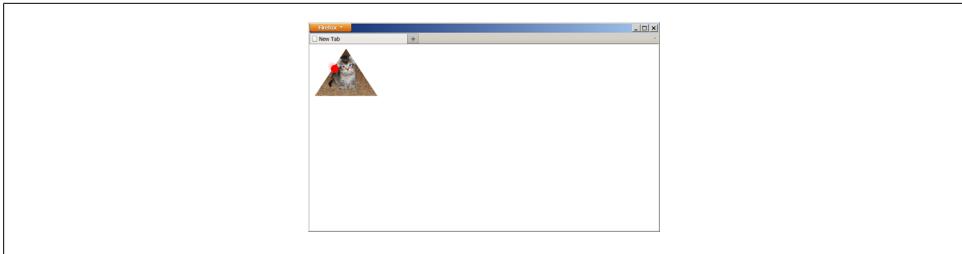


Figure 9-17. Background canvas with an image, and stacked on top of it, a foreground canvas with the animated red circle.

```
erase_circle(ball_x, ball_y);
ball_x += delta;
ball_y += delta;
draw_circle(ball_x, ball_y);
}, 35);
```

This technique of drawing the entire frame, then erasing it and re-drawing it with some things moved or changed works fine, but in certain circumstances, it's not ideal. For instance, if you are animating a shape like our red circle on top of a static drawing (or an image/photo/etc.), it's quite a waste of resources to re-draw the unchanging background image 30 times per second, simply because the foreground shape (red circle) moved and needs to be re-drawn.

One solution to this is to use two `canvas` elements, stacked on top of each other. In the background `canvas` element, draw your static scene image, and in the foreground `can`vas element, do your animation of your red circle as above. This way, the background image is only drawn once, not every time you re-draw the layer with the moving red circle, as shown in [Figure 9-17](#).

In this example, drawing and re-drawing the same red circle in different positions doesn't seem strictly necessary. However, in practical cases, you may be animating more than just the position. For instance, you may animate an object by moving its position and by rotating it at the same time. In such cases, the draw-redraw method of animation is most appropriate.

For this simple case, however, another option would have been to have a `canvas` element in the foreground that was only big enough just for the red circle (20×20), and simply moving that element itself around, using CSS positioning on the page.

Especially for that case, having the red circle separate from the background image is quite helpful, so that the two elements can be positioned independently.

# Drawing Graphs with canvas

## Problem

You have some data that you want to plot in a graph using a `canvas` element.

## Solution

All of the `canvas` API commands discussed in this chapter, plus other advanced commands (for complex curves, etc), can be combined to create very nice looking graphs that visualize data, either as line, pie, or other types of charts.

As you can probably imagine, the complexity of such a task is quite high. So, we will not discuss specifically how to draw your own graphs, but will instead show how to use a simple, free graphing library (which does the hard work for you!) called flot.

The flot library uses jQuery, so you need to load a recent version of jQuery first, and then the latest release of the flot library:

```
<script src="jquery.js"></script>
<script src="jquery.flot.js"></script>
```

Next, you need to create a placeholder element in your page, which flot will render the `canvas` graph into. The flot library will automatically match the bitmap rendered dimensions of the `canvas` element to the size of the placeholder element that you specify:

```
<div id="my_graph" style="width:600px; height:300px"></div>
```

Now, you need to set up the data that you will plot onto your graph. You can either load this data dynamically, using Ajax, or you can include the data inline in your script code, as shown here:

```
var graph_data = [[0, 3], [4, 8], [8, 5], [9, 13]];
```

The format of the data is an array of [X,Y] pairs for each data point, representing values for the X and Y axes for each point, respectively.

Once you have the graph data, if the default graphing options are acceptable, simply call the flot graphing API directly, passing it your data:

```
var my_graph = $("#my_graph"); // get a reference to the placeholder
$.plot(my_graph, [graph_data]); // pass the graph data as one data-series
```

You will notice that we passed the graph data inside [ ], meaning we actually passed an array wrapped around our graph data. The flot graphing API supports graphing multiple data-series at a time on one graph. In our example, our graph data was only one such data-series, but you could have passed other data-series as desired. The default options and styles will result in a nice looking graph, as shown in [Figure 9-18](#).

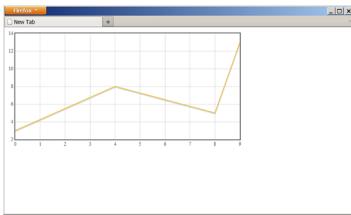


Figure 9-18. Using `flot` to graph some data with a `canvas` element.

You can see that with just a few lines of code, we were able to leverage the power of the `flot` library to generate a professional looking graph, instead of having to write hundreds of lines of our own `canvas` API code.



As an interesting exercise, take your knowledge of the `canvas` API from this chapter's recipes and see if you can reproduce the same graph without using the `flot` library.

The `flot` library API allows you to manually generate and display labels for the X and Y axes, control the minimum and maximum range for each axis, manually define the grid step size for each axis, control colors and line styles, and much more.

## Discussion

The `flot` library is very flexible and powerful. It has a multitude of different options for controlling how graphs are drawn. We will not cover the details of the `flot` API here, but you're encouraged to explore the `flot` API and configuration options here: <http://people.iola.dk/olau/flot/API.txt>.

In addition to the built in graph options, `flot` features a plugin system which allows others to create extensions to its capability. This makes `flot` a very capable browser graphing solution for your sites. Several useful plugins are included with the `flot` distribution, and many others are available for optional usage.

There are of course dozens of other `canvas` graphing libraries available, some free and some for license. These options have a wide range of capabilities, so be sure to explore what's available.

## See Also

For more information on using `flot` to plot graphs in a `canvas` element, see the `flot` homepage: <http://code.google.com/p/flot>.

# Saving a canvas Drawing to a File

## Problem

You want to save the current drawing in a `canvas` element to a file.

## Solution

The `canvas` API provides the command `toDataURL(...)`, which will extract the image data from the `canvas` element into the specified image format. For instance, to extract the image data for a graph generated by flot (see “[Drawing Graphs with canvas](#)” on page 197) as a PNG format file, you would do this:

```
var canvas = $("canvas", my_graph)[0];
var image_data = canvas.toDataURL("image/png");
```

Now that you have the raw image data, you can save the image data as you please.

For instance, to send the image data to a server via Ajax, using jQuery, you might use:

```
$.post("http://location/path/to/upload", {data: image_data});
```

## Discussion

The easy part is extracting the raw image data from the element. The hard part is saving that raw data to an actual file.

If you want to save the file back to a server, you can easily send the data as a string value to the server using Ajax. Once the data arrives on the server, you have to parse out the dataURI format, and then base64 decode the image data, finally saving that information to a file.

If you wanted to then let a user save that file to their computer, you could tell the browser to download that file you just created, which would then prompt the user to save the file on their system.

Some very recent releases of browsers are supporting local file access, so that you can (in theory) allow a user to save the image to their own computer without needing to first upload it to a server and then re-download it.

Because the process of actually handling these files in this way is rather complex (and beyond the scope of this chapter), you can explore Canvas2Image, which takes care of much of this difficult stuff for you: <http://www.nihilogic.dk/labs/canvas2image/>.

## See Also

For more information on saving canvas images to a server (using PHP) and then making them available for users to download and save, see this blog post: <http://blog.kevinsookocheff.com/saving-canvas-data-to-an-image-file-with-javascript-61171>.

# Advanced HTML5 JavaScript

*Kyle Simpson*

## Introduction

HTML5 has dramatically broadened its scope from previous revisions. Whereas HTML4 was primarily focused on markup, HTML5 is focused not only on markup but also on a variety of advanced JavaScript APIs that help bring new features to life.

However, most of these new technologies actually have their own specifications, working groups, etc. So while there is a clear relationship between the new markup that HTML5 brings to the table (pun intended!), it can be confusing to refer to the entire group of technologies under one umbrella term like “HTML5.”

It is for this reason that the trend has become to discuss such APIs as companions to HTML5, as a way of being more precise, or as some have put it, “HTML5 and friends.” So in this chapter, we get familiar with several friends of HTML5.

We’ve already covered the JavaScript APIs behind several markup-anchored elements, such as `canvas`, `audio`, and `video`. Here, our focus is on some other companion APIs, which notably are not necessarily tied to a particular markup element.

You can think of the recipes in this chapter as being the meat on the bones of what it takes to create a truly interactive web application.

It’s important to note that the technologies discussed in this chapter are all in varying degrees of standardization and implementation. They are not universally agreed upon or built into browsers yet, and so using them must be done with some degree of caution and planning. For some things, there are ways to fallback to older or less-capable functionality in non-supporting browsers, but in other cases, you have to build a workflow into your application that will handle when certain features are simply not present.



Because work on these particular sets of technologies is happening so rapidly, and what we know at the time of writing may be outdated by the time of reading, this chapter does not cover directly what things are supported where. You are encouraged to test these features in your target browser environments to get the most updated information on support.

## Local Storage

### Problem

You want to store some data (like user preferences or partially entered form data) persistently on a user's system, so that it's available on a subsequent visit.

### Solution

HTML5 introduced two new APIs for in-browser persistent data storage: `sessionStorage`, which stores data only for the lifetime of the browser instance/session, and `localStorage`, which stores data persistently "forever."

"Forever" in this case means: "until either the code or the user clears it out."

Both interfaces have the same API. The difference between the two is basically how long the browser persists the data.



Data stored in these containers must be strings, so if you need to store complex data objects, one good option is to serialize the object into JSON, using `JSON.stringify()`.

To test if a browser supports either of the Storage APIs, use the following feature-detect:

```
var storage_support = window.sessionStorage || window.localStorage;
```

To store some data for only the current browser instance (goes away when the user closes the browser), use `sessionStorage`:

```
var user_id = "A1B2C3D4";
var user_data = {
  name: "Tom Hanks",
  occupation: "Actor",
  favorite_color: "Blue"
  // ...
};

sessionStorage.setItem(user_id, JSON.stringify(user_data));
```

To store some data for a longer period of time, use `localStorage`:

```
var user_id = "A1B2C3D4";
var user_prefs = {
  keep_me_logged_in: true,
  start_page: "daily news"
  // ...
};

localStorage.setItem(user_id, JSON.stringify(user_prefs));
```

You can see that both code snippets look almost identical, because the APIs are identical.

To pull data (if available) from the storage container:

```
var user_id = "A1B2C3D4";
var user_data = { /* defaults */ };
var user_prefs = { /* defaults */ };

if (sessionStorage.getItem(user_id)) {
  user_data = JSON.parse(sessionStorage.getItem(user_id));
}
if (localStorage.getItem(user_id)) {
  user_prefs = JSON.parse(localStorage.getItem(user_id));
}
```

These Storage APIs allow you to very simply set and retrieve key/value data, where the value is a string, but can represent anything you want, including the string serialization of a complex data object.

## Discussion

At first thought, the most likely solution for storing data client-side that popped into your head is cookies. However, cookies have a number of problems that make them less than ideal for storing user data. In this chapter we explore a new alternative: the HTML5 Storage (also known as “DOM Storage”) APIs.

Both the `sessionStorage` and `localStorage` APIs share the same API, but the difference—as belied by their names—is in how long they persist the data.

For data that you only need to persist for the lifetime of a browser session—things such as user login data, shopping cart contents, etc.—the `sessionStorage` API is probably your best option. For more long-lived data—things such as application preferences—`localStorage` may be a better option.



Many browsers even persist `sessionStorage` data across browser crashes. This makes a great container to temporarily mirror data being entered into form fields. For example, just in case the browser crashes, you can restore what they were typing.

The APIs for both `sessionStorage` and `localStorage` are identical:

`getItem(key)`

Returns an item of data from the storage container, referenced by its key

`setItem(key, item)`

Adds an item of data to the storage container, referenced by its key

`key(index)`

Returns the key for an item of data at the numerical index specified

`removeItem(key)`

Removes an item from the storage container, referenced by its key

`clear()`

Clears out all data in the current storage container

`length`

Identifies how many items of data are in the storage container

Most browsers give up to 5MB of space for these storage containers. For most practical applications, this is far more than enough. Be prepared to detect and handle errors though if you are writing more data than the browser allows.

Unlike cookies (which have explicit expirations) and `sessionStorage` (which has implicit expiration at the end of the browser instance/session), the `localStorage` API has no expiration at all. This has both good and bad consequences.

The benefit is that data stays around as long as you need it to unless the user explicitly clears it themselves, but the downside is that the 5MB limit may be reached more quickly than anticipated, especially if old data is abandoned and left forever to sit idle in the storage container.

One common solution is to implement a custom expiration mechanism, by storing a timestamp with each piece of data, and then checking each piece of data manually on each page-load to see if any old data needs to be removed.

For instance, your e-commerce site might keep a record of all items the user has viewed across various visits, so it can display that in a “Previously Viewed” area. But, you don’t want the application to remember those items forever. So, you might manually expire entries that are older than 21 days:

```
// first, store the currently viewed item in the history
var current_item = {
  id: "ABCD0123",
  data: "Mens' Running Shoes",
  ts: new Date() // current timestamp, used for expiration check later
};
localStorage.setItem(current_item.id, JSON.stringify(current_item));

// now, manually "expire" all old entries
var key, data;

for (var i=0; i<localStorage.length; i++) {
  key = localStorage.key(i);
  data = localStorage.getItem(key);
```

```
if (data.ts < ((new Date()) - 60*60*24*21)) { // more than 21 days old
    localStorage.removeItem(key);
}
}
```

Both APIs restrict access to reading and writing data to the exact page domain (domain, sub-domain, schema, port, etc.) as the hosting page, meaning that you cannot share data across different domains with either of them. This is both a helpful and frustratingly restrictive reality.

The benefit is that data is well protected privacy-wise (from other snooping sites), but the downside is that your application's different services on different domains cannot share their data through this interface.

## See Also

For more information on the DOM Storage APIs, see this MDC entry: <https://developer.mozilla.org/en/dom/storage>.

# Application Caching

## Problem

You want to make your web application (including all its resources) available to users even in an offline state, without relying on the normal browser cache.

## Solution

HTML5 defines a special application cache, commonly called “appcache”, that allows you to instruct the browser to cache certain resources—like images, CSS, JS, and others—in a way that makes them available to the application even if the user’s browser is offline and not connected to the public internet.

To test if the browser supports appcache functionality, use the following feature-detect:

```
var appcache_support = !!window.applicationCache;
```

To utilize appcache in your application, first you need to create a manifest file, which lists the resources you want in the appcache. This file might look like:

```
CACHE MANIFEST
```

```
CACHE:
index.html
help.html
style/default.css
images/logo.png
images/backgound.png
```

The `appcache` manifest file should include a “CACHE” section for listing the resources you want to include in the `appcache`. You can also specify a “NETWORK” section for URLs that need to be dynamically called (e.g. via Ajax), and which should never be cached. A “FALLBACK” section can also be specified, which lists local (cached) file fallbacks for any remote URL request that fails (such as default content in an offline scenario for a normally online call to a server API).



Applications executing in the `appcache` context are not allowed to connect to remove URLs unless those URLs are listed within the “NETWORK” section of the manifest. This is to provide an additional layer of security to applications, preventing them from contacting servers that aren’t known and whitelisted.

Once you have the manifest file—in this example we’ve named it “`cache.manifest`”—tell the browser about the file by adding a property to the `html` element in your markup, like so:

```
<html manifest="cache.manifest">
```



The cache manifest file must be served with the mime-type “`text/cache-manifest`.”

That’s it! Now your application is offline-capable via `appcache`. The browser persistently caches these listed resources and does not re-request them on subsequent page loads, unless the cache manifest file changes.

### Updating the `appcache`

Simply changing a file that is stored in a user’s `appcache` is *not* enough to get that new version of the file delivered to the user. The only way a browser checks for updated versions of files in its `appcache` (and subsequently downloads any changes), is if the manifest file changes.

However, you may not have any changes to make to the manifest file itself if, for example, there are no new resources to list and none to remove.

So, one easy approach is to include a comment in your file, which you can update with a new value when you change one or more files and want the browser to update its `appcache`:

```
CACHE MANIFEST  
# cache version: 1257
```

```
CACHE:  
index.html
```

```
help.html  
style/default.css  
images/logo.png  
images/backgound.png
```

Each time you update a resource that is in the `appcache`, simply bump up the version number in the comment. The next time a user loads the page, the browser sees this new cache manifest file and updates the `appcache` contents.

There's a catch, however.

Even if the browser sees during page load that the manifest file has changed, it still lets the current page load continue immediately, with the now out-of-date `appcache` contents, and then asks for the updated files to be loaded in the background, to be ready for the *next* page load.

Fortunately, the browser provides a JavaScript API to help: the `applicationCache` interface. Using this interface, you can detect that a new set of `appcache` contents has been fetched and is now available, and force them to be applied to the `appcache` right away, rather than on the next page load:

```
var cache = applicationCache;  
cache.addEventListener("updateready", function(){  
    if (cache.stats == cache.UPDATEREADY) {  
        cache.swapCache(); // swap in the new cache items  
    }  
}, false);
```

This makes the new `appcache` items available for any further uses during the current page lifetime.

However, any places where the resources were already used on the page are not updated. That can be a strange user experience depending on the situation.

The cleanest way to force the entire page to be updated with the new resource versions is to simply reload the page. But, be kind to the user, and first ask them if they want to reload the page, like this:

```
var cache = applicationCache;  
cache.addEventListener("updateready", function(){  
    if (cache.stats == cache.UPDATEREADY) {  
        if (confirm("This site has been updated. Do you want to reload?")) {  
            location.reload();  
        }  
    }  
}, false);
```

So far, we've only seen how to respond to cases where the `appcache` is marked for updating during a page load. However, some sites are designed to be long-lived, with little or no page reloads, in which case, getting updates requires special handling.

To force the browser to do a check for an updated “cache.manifest” file, which if modified then force fetching of any new `appcache` contents, you can call the `update()` API method:

```
function updateAppcache(){
    var cache = applicationCache;
    cache.update(); // check to see if the cache manifest file has been updated

    cache.addEventListener("updateready", function(){
        if (cache.stats == cache.UPDATEREADY) {
            if (confirm("This site has been updated. Do you want to reload?")) {
                location.reload();
            }
        }
    }, false);
}
```

Typically, you would wire up such a check to happen either on an automatic time interval such as every 24 hours, or in response to a specific application action, such as the user clicking a button in your page.



If you perform `appcache` updates on an automatic time interval, prompting the user before a reload is probably the friendliest approach. However, if the user initiates the update, you can probably safely reload the page without prompting, as soon as the `appcache` is updated.

## Discussion

We mentioned that the `appcache` is special, and the reason for that assertion is that unlike the browser cache, resources that are in the `appcache` never expire (similar to the `localStorage` interface we discussed in [“Local Storage” on page 202](#)).

Practically speaking, this means any resources listed in the cache manifest are cached rather permanently, and more specifically, the browser does not re-request any of those resources on subsequent page loads.

The persistent caching of resources definitely improves performance on subsequent page views, especially on bandwidth-limited mobile devices.

However, it’s sometimes necessary to be able to update one or more items in that persistent cache.

There are two ways to go about forcing the browser to discard its cache and update the resources listed in the manifest.

One technique is useful for subsequent page loads, while the other is useful for updates during the lifetime of a single page view.

It’s important to understand that if an `appcache` already exists for a page at the time of page load, even if it’s determined to be out of date by virtue of finding an updated cache

manifest file, the browser immediately uses the current `appcache` to render the page, and any updates to `appcache` contents are available only on the *next* page load.

Using JavaScript via the `UPDATEREADY` event as shown above, you can detect that the current page was rendered with out-of-date cache items, and force update the `appcache` during that page view. This allows any subsequent uses of resources in the page lifetime to use the updated versions of the files. You can also just reload the entire page to use the new `appcache` contents everywhere, as long as this is okay with the user!

The `appcache` is considered to be more reliable for offline application resource caching than the normal browser cache. It also provides a JavaScript API for interacting with updates—something the regular browser cache doesn’t provide.

## See Also

This beginner’s guide provides an introduction to `applicationCache` functionality: <http://www.html5rocks.com/en/tutorials/appcache/beginner/>.

For more i-depth information on the `applicationCache` API, see this MDC entry: [https://developer.mozilla.org/en/offline\\_resources\\_in\\_firefox](https://developer.mozilla.org/en/offline_resources_in_firefox).

In addition, <http://appcachefacts.info> has a great discussion of important nuances of `appcache` behavior.

# Drag and Drop

## Problem

You want to implement native drag and drop functionality without managing mouse events manually or using a complex library.

## Solution

Recognizing how common drag and drop interaction is in today’s complex web applications, HTML5 now defines a direct API for handling drag and drop (“D&D”).

To test if the browser supports native D&D functionality, use the following feature-detect:

```
var dnd_support = 'draggable' in document.createElement('span');
```

Now, let’s build a simple D&D demo. Let’s begin by setting up some visual styles for our D&D elements:

```
<style>
#foobar { background-color:yellow; width:100px; height:100px; cursor:move; }
#catcher { background-color:blue; width:150px; height:150px; padding:5px; margin-bottom:5px; }
</style>
```

The first step in enabling native D&D is to put the `draggable` attribute on the element you want to be drag-enabled:

```
<div id="catcher">...</div>
<div id="foobar" draggable="true">...</div>
```

Next, we need to use the JavaScript API and D&D events to tell the browser where the element can be dragged to, and what to do once it's dropped there.

For example, we can listen for the `dragstart` event, and style the element differently when it's being dragged (like putting a border around it or making it partially transparent).

```
var foobar = document.getElementById("foobar");
foobar.addEventListener("dragstart", function(evt) {
    this.style.border = "3px dotted #000"; // black dotted-line border
}, false);
```

Now, let's style an element that can receive the drop, so that when the dragged item is over it, it makes it obvious that you can drop the element there (as opposed to just dropping it in any location):

```
var catcher = document.getElementById("catcher"); // will catch the dropped element
catcher.addEventListener("dragenter", function(evt) {
    this.style.border = "3px solid red"; // make the catcher have a red border
}, false);

catcher.addEventListener("dragleave", function(evt) {
    this.style.border = ""; // remove the border from the catcher
}, false);

catcher.addEventListener("dragover", function(evt) {
    if (evt.preventDefault) evt.preventDefault();
    return false;
}, false);
```

In the preceding snippet, we added event listeners to the element that catch our dropped element for the `dragover`, `dragenter`, and `dragleave` events. The `dragenter` and `dragleave` events simply toggle on a red border to our target element to make it clear that you can drop the element there, as shown in [Figure 10-1](#).

The `dragover` event is fired continuously while dragging around on top of the target. So we would not want to toggle on the red border in that handler, as that would create unnecessary work for the browser. However, we do need to prevent that event from various default behavior, depending on the type of element being dragged. This is why we use `preventDefault()` and `return false`.

Lastly, we need to wire up a `dataTransfer` object with data that the browser needs for handling the D&D actions. So, we'll modify our `dragstart` event handler like so:

```
foobar.addEventListener("dragstart", function(evt) {
    this.style.border = "3px dotted #000"; // black dotted-line border

    evt.dataTransfer.effectAllowed = "move";
```

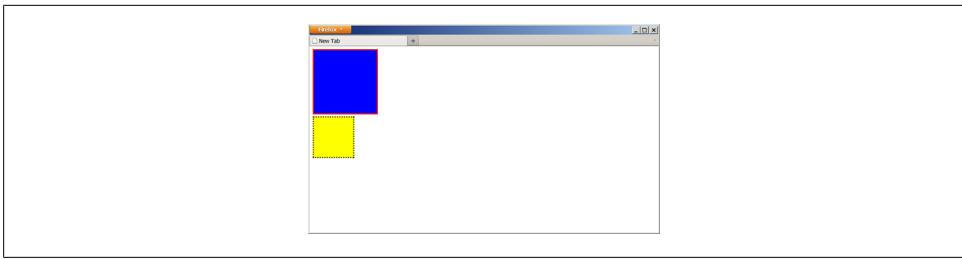


Figure 10-1. Showing the drag event in progress, dragging the yellow box into the blue box.

```
    evt.dataTransfer.setData("Text", this.id);
}, false);
```

The `effectAllowed` property controls what visual feedback—generally the mouse cursor—the browser gives on the type of drag event that is occurring (move, copy, etc.).

The `setData(...)` method tells the D&D mechanism in the browser which data from the element being dragged should be dropped into the target element, otherwise known as the drop catcher. Here we specify that only the `id` property of the original element is transferred, which is used later to actually move the element.

Now, we need to define a `dragend` event handler to clear up the visuals, and a `drop` event handler, to actually do the moving of our element:

```
foobar.addEventListener("dragend", function(evt) {
  this.style.border = ""; // remove the border
}, false);

catcher.addEventListener("drop", function(evt) {
  if (evt.preventDefault) evt.preventDefault();
  if (evt.stopPropagation) evt.stopPropagation();

  this.style.border = ""; // remove the border from the catcher

  var id = evt.dataTransfer.getData("Text"); // get the id
  var elem = document.getElementById(id);
  elem.parentNode.removeChild(elem); // remove the element
  this.appendChild(elem); // add the element back into our catcher

  return false;
}, false);
```

In the `drop` event handler, we first get the data that was transferred in the drop, which in this case was the `id` property of the original source element that we dragged. Next, we remove that element from its current location, and finally add it back into the new location inside our catcher container. The result is shown in [Figure 10-2](#).

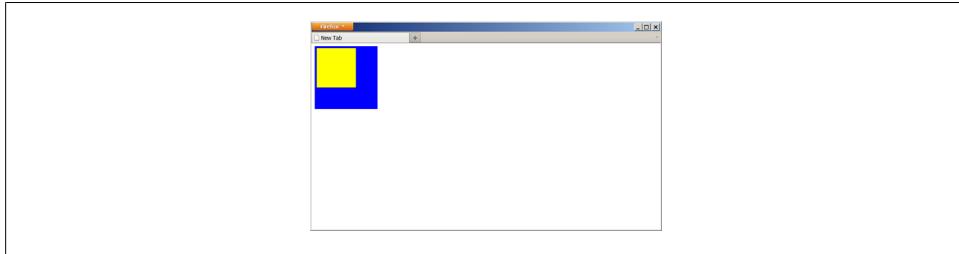


Figure 10-2. Showing the results of dragging the yellow box into the blue box.

## Discussion

The native HTML5 drag and drop API is both useful and quite complex. As you can see from the previous code snippets, it doesn't require an entire complex library to enable D&D on your site, but it's not particularly trivial either. But with complexity comes lots of flexibility.

The first most obvious thing you'll notice when attempting to run the above code yourself (not entirely obvious just from the screenshots) is that the yellow box itself doesn't move while you are holding down the mouse button and moving the mouse.

Different browsers render this experience slightly differently, but in general, the yellow box stays put during the drag, and what shows is a different icon for the mouse cursor, to let the user know that a D&D event is in progress.

This may seem a bit counter-intuitive: dragging an element doesn't actually move the element itself while dragging.

You might expect it to work the same as if you drag a window around on your desktop —the window tracks along directly under the mouse cursor as you move.

On the other hand, if you drag an icon around on the Windows OS desktop, the icon doesn't move with the mouse—it only moves once you let go of the mouse button and stop the drag (this is the drop). This latter experience is more closely aligned with how native D&D works in HTML5.

Consider that native D&D is designed so you can drag all sorts of different things, not all of which have visual representations like our yellow box does.

As such, native D&D does not necessarily imply actually moving any element on the page. Instead, D&D is about dragging a reference from one object to another and connecting the two in a D&D event, whereby you can then decide what that connection means and how to respond.

The events associated with native D&D are:

**dragstart**

called when the “draggable” element first starts being dragged

**dragend**

called at the end of a drag event, successful or canceled.

**dragenter**

called on a target drop container when the drag first moves over the target

**dragleave**

called when the drag moves off the target

**dragover**

called continuously while the drag is over the target

**drop**

called when the drag event is completed by dropping the element onto the target drop container

Sometimes, you might just be copying invisible attributes from one element to another. Other times, you might be initiating some action like deleting, by moving an element onto a trash icon. In our example, we are re-positioning the yellow box inside the blue box, so once the D&D event finishes, we actually move of the yellow box.

Since the yellow box is visible, it seems to make sense that we might want to move it around as we drag (like when dragging a window). However, the typical JavaScript approach to this does not work, because the `mousemove` event does not fire during a D&D action. The global `drag` event does fire on the document, but cross-browser it doesn't reliably have coordinates we can use to position the element.

If you need to actually move an element around during the drag, it's best not to use native D&D... for now, anyway. Hopefully this shortcoming is addressed eventually. Until then, use established patterns and/or libraries for emulating D&D with mouse events.

Another very advanced usage of the native D&D functionality that is on the horizon is the ability to drag items between windows, or between your browser and the desktop, and vice versa.

For instance, you can drag a file from your desktop and drop it onto a target on a web page. Responding to the drop is identical to the code snippets above—the only difference being that you didn't need an element on your page with the `draggable` attribute to be the thing that you dragged. For example:

```
catcher.addEventListener("drop", function(evt) {
  if (evt.preventDefault) evt.preventDefault();
  if (evt.stopPropagation) evt.stopPropagation();

  this.style.border = ""; // remove the border from the catcher

  var files_array = evt.dataTransfer.files;
  // now, you have a reference to the file(s) that the user dragged
  // onto your page. Do something cool with them!
```

```
        return false;
}, false);
```

As you can see, the native D&D functionality is focused on data transfer between two elements, rather than on moving an element from one position to another. This really helps us out here big time. We receive in the `dataTransfer.files` property a list of references to the file(s) that the user chose to drag onto our application. There was nothing visual about this operation—it was entirely about dragging data (file references) from the desktop to an element on our page!

Now, once we have a reference to a file on the user's system, what can we do with it? We address that in “[Local Files](#)” on page 226 Local Files.

There is likely be a lot of changes to this advanced functionality before it settles and is standardized across all browsers. But it's exciting to know that it's coming soon!

## See Also

For more information on the native HTML5 Drag and drop, see this tutorial: <http://www.html5rocks.com/en/tutorials/dnd/basics/>.

# Web Workers

## Problem

You want to run a complex, long-running JavaScript task without locking up the UI in the browser.

## Solution

You need to run the JavaScript task in a separate thread, and the way to do this is with the `Worker` API, otherwise known as Web Workers.

Web Workers create a special environment for JavaScript code to run in that occurs in a separate thread from the main UI of your page. This means that your page's UI won't be locked up if you have particularly long-running JavaScript code.

To test if the browser supports Web Workers, use the following feature-detect for the `Worker` API:

```
var webworkers_support = !!window.Worker;
```

Now let's build a simple Web Workers demo. We'll initialize a large 2-dimensional array with random numbers, a task that may take long enough to cause a noticeable UI delay.

You might use such a 2-D array of random numbers to represent random pixels in a `canvas` element (see [Chapter 9](#)). Two nested for-loops do the trick:

```
var data = [];
for (var i=0; i<1500; i++) {
    data[i] = [];
    for (var j=0; j<1500; j++) {
        data[i][j] = Math.random();
    }
}
```

Nothing particularly exciting going on here. Such an array, with 2.25 million ( $1500 \times 1500$ ) operations to initialize it, may very well lock up the UI for anywhere from 2 to 30 seconds, depending on browser and device capability.

A more graceful way to handle this, without locking the UI, is to put such an operation into a separate thread, a Web Worker, and simply wait to be notified of it finishing before continuing.

To do this, first put this code above into a separate file, called for instance “init\_array.js”, and wrap the code in an `onmessage` event handler:

```
self.onmessage = function(evt) {
    var data = [];
    for (var i=0; i<1500; i++) {
        data[i] = [];
        for (var j=0; j<1500; j++) {
            data[i][j] = Math.random();
        }
    }

    self.postMessage(data);
    data = null; // unassign our copy of the data now, to free up memory
}
```

This is the code for the Web Worker. The code first tells the worker to listen for the `message` event, which lets the worker know when to start.

Once started, the worker performs the long-running computation. Finally, the worker sends back a message (the data array in our example) using `postMessage(...)`, to the main page. Workers can also be started by other workers, and the communication works exactly the same.



Different from normal JavaScript operations, where passing an object around is done by reference, the data passed in worker messages is *copied*, which means that double the memory is consumed during the transmission. For most types of data, this is not an issue to be concerned with.

But in our example with the large array, the considerable memory usage is something to watch out for issues on memory-limited mobile devices. To conserve memory, only keep variables with large amounts of data in them around for the shortest amount of time necessary.

In the main page of our UI, we create the worker, pointing it at the appropriate file. Then we set up a listener for the `message` event, to receive the message (the initialized array) from the worker when it finishes its job. We start the worker by sending it an empty message using `postMessage()`:

```
var worker = new Worker("init_array.js");

worker.onmessage = function(evt) {
    alert("Data array initialization finished!");
    var data = evt.data;
};

worker.postMessage(); // tell our worker to start his task
```

## Discussion

Web Workers are very useful for offloading complex or long-running tasks to another thread, something that JavaScript itself cannot do.

If Web Workers are not supported in a particular browser, you'll need to just run your code in the main JavaScript thread, and deal with the delays it may cause. In some circumstances, you can break up your long-running code into smaller chunks, and run each chunk at a time, pausing briefly in between to let the UI update before resuming. For example:

```
function doNextChunk() {
    var done_yet = false;
    for (var i=0; i<500; i++) { // do 500 iterations at a time
        // do something
        // when done, set `done_yet` = true
    }
    if (!done_yet) setTimeout(doNextChunk,0);
    else alert("All done finally!");
}

doNextChunk();
```

Using a `setTimeout(...,0)` pattern, we do 500 iterations of a long-running loop, then pause for a brief moment long enough for the UI to update, then we resume and do another 500 iterations, etc. This technique has better performance than letting a long-running piece of code tie up the UI indefinitely. But the performance is still far less efficient than if Web Workers can be used.

By creating a Web Worker, you are creating a bridge between your main JavaScript in your page, and a sandboxed piece of JavaScript running in another thread. These two sides of the bridge communicate with each other by asynchronously sending and receiving messages, using `postMessage(...)` and listening for the `message` event.



An asynchronous Ajax call using XMLHttpRequest ("XHR") to a server is quite similar to sending and receiving asynchronous messages to/from a Web Worker.

The Web Workers communication interface also allows errors to be sent and received. To signal an error from inside a worker, simply `throw` a JavaScript error, like so:

```
self.onmessage = function(evt) {
    var data = [];
    for (var i=0; i<1500; i++) {
        data[i] = [];
        for (var j=0; j<1500; j++) {
            data[i][j] = Math.random();
            if (data[i][j] == 0) {
                throw "I don't like zeros in my array!";
            }
        }
    }

    self.postMessage(data);
    data = null; // unassign our copy of the data now, to free up memory
}
```

To receive an error message from a worker, listen for the `error` event:

```
var worker = new Worker("init_array.js");

worker.onerror = function(err) {
    alert("An error occurred in the initialization of the array.");
    throw err; // optional
}

worker.onmessage = function(evt) {
    alert("Data array initialization finished!");
    var data = evt.data;
};

worker.postMessage();
```

A Web Worker is sandboxed away from the main page, and basically can only communicate with the page using these messages. That means the worker cannot access the DOM to read or modify any information. Also, UI-centric tasks like calling an `alert(...)` dialog are not allowed.

However, a worker does have several helpful things available to it. The worker can access the `navigator` object, to identify the user agent (browser) running it. A worker can also load scripts into it, using the `importScripts(...)` command.

```
if (navigator.userAgent.test(/MSIE/)) { // UA sniffing is *bad* practice!!
    importScripts("ie_helper.js");
}
self.onmessage = function(evt) {
```

```
    /* ... */  
}
```



loadScripts(...) loads one or more scripts in parallel, but always executes them in the order requested.

Also, loadScripts(...) executes synchronously, meaning it blocks the rest of the worker until it finishes loading and executing the scripts.

A worker may spawn another worker, exactly the same as we've just seen. A worker may also be terminated by the code which created the worker, by calling `terminate()` on the worker instance.

Finally, workers may use timeouts and intervals, including `setTimeout(...)`, `clearTimeout(...)`, `setInterval(...)`, and `clearInterval(...)`. This would be useful if, for instance, you wanted to have a worker running in the background every so often, notifying the page each time it runs:

```
self.onmessage = function(evt) {  
    setInterval(function(){  
        self.postMessage(Math.random()); // send a random number back  
    }, 60*60*1000); // execute once per hour  
}
```

## Web Sockets

### Problem

You want to create persistent, two-way communication between your web application and the server, so that both the browser and the server can send and receive data from each other as needed.

### Solution

Most browsers now have the native ability to establish a bi-directional socket connection between the browser and the server, using the `WebSocket` API. This means that both sides (browser and server) can send and receive data.

Common use cases for Web Sockets are live online games, stock tickers, chat clients, etc.

To test if the browser supports Web Sockets, use the following feature-detect for the `WebSocket` API:

```
var websockets_support = !!window.WebSocket;
```

Now, let's build a simple application with chat room type functionality, where a user may read the current list of messages, as well as add their own message to the room.

We'll have a text entry box where new messages are written before being sent, and we'll have a list of messages in the chat room. We don't need features such as login or authentication here—only simple chat room message sending and receiving.

```
<!DOCTYPE html>
<html>
<head>
<title>Our Chatroom</title>
<script src="chatroom.js"></script>
</head>
<body>
<h1>Our Chatroom</h1>

<div id="chatlog"></div>

<input id="newmsg" /><br />
<input type="button" value="Send Message" id="sendmsg" />
</body>
</html>
```

Now, let's examine the JavaScript in "chatroom.js":

```
var chatcomm = new WebSocket("ws://something.com/server/chat");

chatcomm.onmessage = function(msg) {
    msg = JSON.parse(msg); // decode JSON into object

    var chatlog = document.getElementById("chatlog");
    var docfrag = document.createDocumentFragment();
    var msgdiv;

    for (var i=0; i<msg.messages.length; i++) {
        msgdiv = document.createElement("div");
        msgdiv.appendChild(document.createTextNode(msg.messages[i]));
        docfrag.appendChild(msgdiv);
    }

    chatlog.appendChild(docfrag);
};

chatcomm.onclose = function() {
    alert("The chatroom connection was lost. Refresh page to reconnect.");
};

document.getElementById("sendmsg").addEventListener("click", function(){
    var newmsg = document.getElementById("newmsg");

    chatcomm.send(newmsg.value); // send the message to the server
    newmsg.value = ""; // clear out the message entry box
}, false);
```

Let's break down that code just a little bit. First we create the socket and point it at a location on our server. The server URL in our example uses the "ws://" protocol, as opposed to the more common "**Error! Hyperlink reference not valid.**" you're fa-

miliar with. This signals the special protocol that Web Sockets use between client and server.

Next, we set up two event listeners on our socket object: `onmessage` and `onclose`. The `onclose` handler is self-explanatory—it is fired when the connection is closed.



The server-side implementation of this chat-room demo is beyond the scope of this chapter, but there are lots of tutorials and software projects for making this very easy to do in any of your favorite server-side languages, including PHP, JavaScript (`node.js`), Java, etc.

Such a chat-room server just needs to implement basic send and receive actions much like the JavaScript you see here for the client. As a basic implementation, the server doesn't even need to persist the messages; it can just publish each message out to the socket stream as it is received, meaning that all clients that are currently connected see it.

Our `onmessage` handler receives a string of data (which in our example we expect to be JSON), and parses it into a message object. The message object has an array of one or more messages (each one is just simple text). The handler loops through each message, adding it to the chat log in the order received.

Lastly, the code sets up a `click` event handler on the “Send Message” button. When clicked, the handler takes whatever has been typed into the entry input, and sends it to the server, using the `send(...)` method.

## Discussion

Admittedly, this type of functionality is not new at all. Since the advent of Ajax, using the `XMLHttpRequest` (“XHR”) object, developers have been sending and receiving data between browser and server. Other approaches have included instantiating an invisible flash object and using flash’s socket communication capabilities.

However, it’s quite inefficient in the XHR approach to establish a whole new connection for each piece of data you need to send from browser to server. It’s similarly undesirable to instantiate a memory-heavy Flash instance to use socket communication.

So, Web Sockets are understandably a welcomed addition to the “HTML5 & Friends” family of technologies.

The message sending and receiving in Web Sockets is like a sensible mix between XHR and Web Workers that we saw in [“Web Workers” on page 214](#).



Web Sockets requires both the browser and the server to speak a standardized and agreed upon protocol (much like HTTP is for normal web pages). However, this protocol has undergone quite a lot of experimentation and change as it has developed over the last couple of years.

It is beginning to stabilize a little bit, but Web Sockets are still quite volatile. And you have to make sure that your server is speaking the most up-to-date version of the protocol so that the browser can communicate properly with it.

The `WebSocket` object instance has, similar to XHR, a `readyState` property, which lets you examine the state of the connection. It can have the following constant values:

```
{worker}.CONNECTING (numeric value 0)  
    connection has not yet been established  
{worker}.OPEN (numeric value 1)  
    connection is open and communication is possible  
{worker}.CLOSING (numeric value 2)  
    connection is being closed  
{worker}.CLOSED (numeric value 3)  
    connection is closed (or was never opened successfully)
```

The events that a `WebSocket` object instance fires are:

```
open  
    called when the connection has been opened  
message  
    called when a message has been received from the server  
error  
    called when an error occurs with the socket (sending or receiving)  
close  
    called when the connection is closed
```

For each of these events, you can add an event listener using `addEventListener(...)`, or you can set a corresponding handler directly on the worker object instance, including `onopen`, `onmessage`, `onerror` and `onclose`.

If Web Sockets are not supported, you'll need to provide some fallback functionality for your application, or at least gracefully notify the user that their browser doesn't support the required functionality. Fortunately, there's a very easy way to do that.

Because consistent browser support for Web Sockets has been elusive, the best practice suggestion for using Web Sockets is to use a library like [Socket.io](http://socket.io/) (<http://socket.io/>), which attempts to use Web Sockets if available, and falls back to a variety of other techniques for communication if Web Sockets are not present.

You should also be aware of how Web Sockets usage scales in terms of server resources. Traditional web requests only take up dedicated resources from the server for a split second at a time, which means you can serve a lot of web traffic from your server without having too much overlap and thus running out of resources.

Sockets on the other hand tend to be more dedicated, and so there can be issues with resource availability under high load. Your server setup and architecture vary greatly with your application's needs, and are a big factor in how well you are able to utilize Web Sockets.

## See Also

For more information about Socket.io, see the project homepage at: <http://socket.io/>.

## History

### Problem

For your web application, you want fine-grained control to manage the forward/backward button history queue, as well as the displayed URL in the address bar of the browser.

### Solution

HTML5 brings us several important enhancements to the browser's `window.history` object, commonly referred to as the `History` API.

To test if the browser supports the enhanced `History` API, use the following feature-detect:

```
var history_support = !(window.history && window.history.pushState);
```

Normally, when you change the URL in the address bar, the browser initiates a new request to the server for that new page. But, today's complex web applications more commonly use Ajax to load only new information, without full-page refreshes. This leads to a disconnect, where web applications can't update the address bar URL, because they don't want a browser page refresh.

To change the URL in the address bar without forcing a new page load, use the `history.pushState(...)` method. This method updates the URL in the address bar, and creates a special state-oriented entry in the browser's history.



The new URL you pass to `pushState()` or `replaceState()` must be the same origin (domain, etc) as the current page, or the API throws an error. You can change the path, filename, query string, and hash portions of the URL, just not the protocol/schema, domain, or port.

It would make no sense, and indeed would be a security risk, to allow mixing of URL origins in the state queue. Use normal location/history manipulation if you need to navigate across different origins.

That means that if a user then clicks the back button in their browser, instead of doing a reload of the previous page, the browser fires the new `popstate` event, which your application can respond to by setting the page back to that previous state.

Let's take a look at an example of how these two additional functionalities work together to allow you to handle forward/backward navigation with only state changes (and not separate page loads), as well as keeping the displayed URL in the address bar up to date.

Our example keeps track of whether an element is visible or not, and maintains this state in the browser's forward/backward navigation stack—as well as reflecting that state in the browser address bar URL—so that the current state can be copied and pasted or bookmarked:

```
<html>
<head>
<title>History Example</title>
<script>
function showText(updateHistory) {
    document.getElementById("long_desc").style.display = "block";
    if (updateHistory) history.pushState(null, null, "?show");
}
function hideText(updateHistory) {
    document.getElementById("long_desc").style.display = "none";
    if (updateHistory) history.pushState(null, null, location.href.replace(/\?show/, ""));
}
function toggleText() {
    var elem = document.getElementById("long_desc");
    if (elem.style && elem.style.display == "none") showText(true);
    else hideText(true);
}
function manageText() {
    if (location.href.match(/\?show/)) showText();
    else hideText();
}

window.addEventListener("popstate", manageText, false);
window.addEventListener("DOMContentLoaded", function(){
    document.getElementById("toggle").addEventListener("click", function(e){
        toggleText();
        e.preventDefault();
        return false;
    }, false);
}, false);
```

```

        manageText();
    }, false);
</script>
</head>
<body>
<p>Here's a short description.</p>
<a id="toggle" href="#">toggle</a>
<p id="long_desc">Here's a longer description, which can be shown or hidden.</p>
</body>
</html>

```

If you run this demo, and click successively on the “toggle” link, you’ll see that the the longer text description paragraph is indeed toggled on and off. You’ll also notice that when the paragraph is visible, the URL has “?show” in it, and when it’s hidden, this parameter is removed. Finally, you will notice the forward/backward navigation cycles through these states, showing and hiding the paragraph as appropriate.

Try copying and pasting the URL while the “?show” is visible, and pasting that into a new browser tab, and you’ll see that indeed the paragraph is visible—the state really was preserved in the URL, as we wanted.

The above example keeps track of the state changes in the forward/backward queue of the browser. For some applications, this is desirable. For other applications, polluting the forward/backward queue with lots and lots of intermittent state changes is not appropriate.

So, instead of using `pushState(...)`, use `replaceState(...)`, which, as the name implies, replaces the current state entry in the forward/backward navigation with the new desired state. If we do that for our example above, it looks like this:

```

//...

function showText(updateHistory) {
    document.getElementById("long_desc").style.display = "block";
    if (updateHistory) history.replaceState(null, null, "?show");
}
function hideText(updateHistory) {
    document.getElementById("long_desc").style.display = "none";
    if (updateHistory) history.replaceState(null, null, location.href.replace(/\?show/, ""));
}

//...

```

Running that updated demo, you’ll see that the toggle behavior and the URL all behave the same. The only difference is that there’s no forward/backward queue state to cycle through.

## Discussion

The browser has long supported a History API. The difference that HTML5 brings is the enhanced functionality of `pushState(...)`, `replaceState(...)` and `popstate`.

Before the HTML5 History API enhancements were added to browsers, the only way to emulate the functionality described above was using the URL’s “hash” (the end of a URL that looks like “#some|stuff|here”).

Most browsers agree on behavior that if you change the current page’s hash, then the browser saves that state in the forward/backward queue, update the displayed URL, and suppress the browser from requesting a new page from the server.

On the surface, that sounds just like what we’re looking for. However, there are several browser quirks (race conditions, etc) which make dealing with hash changes hard to get consistent and reliable.

In particular, older browsers don’t all support the `hashchange` event, which is very helpful in monitoring the state of the URL hash, in case a user copies and pastes a URL into the address bar. Without that event, you must poll the URL hash using a timer.

Fortunately, all this mess is generally taken care of by various helper libraries. One particularly useful library is `History.js` (<https://github.com/balupton/history.js>), which attempts to use the new HTML5 History API enhancements, and falls back to URL hash management automatically.

The above code example stores a simple state in the URL (“?show”). This is good for the copy/paste (or bookmarking) use case, as the entirety of the state is in the URL and thus restorable.

If you have a more complex set of states to manage, and copy/paste or bookmarking is not important, you can actually store a much richer and more complex set of states with each entry. This complex state is saved with an entry, and then retrieved and sent back to your application via the `popstate` event handler as the user navigates back with the back button.

The first parameter to `pushState(...)`/`replaceState(...)` is the `state` object, which can be any arbitrarily complex object that you need, as long as it’s serializable to a string value.

For example:

```
window.addEventListener("popstate", function(e){
  alert("Current state data: " + JSON.stringify(e.state));
}, false);

window.pushState({foo:"bar"}, null, "?foobar");
window.pushState({bar:"baz"}, null, "?barbaz");
history.back(); // triggers `popstate` to go back to the "?foobar" page/state
```



Browsers currently don’t support the second parameter, which is a “title” for the new state, so just pass `null` or an empty string for that parameter.

## See Also

- For more information about using the API, see the following MDC entry: [https://developer.mozilla.org/en/DOM/Manipulating\\_the\\_browser\\_history](https://developer.mozilla.org/en/DOM/Manipulating_the_browser_history).
- For more information about History.js, see the github repo at: <https://github.com/balupton/history.js>.

## Local Files

### Problem

You want users to be able to read an image file from their local file-system, and do something with it in the webpage, such as previewing or uploading it.

### Solution

Prior to HTML5, the only interaction users could have with their local file system was through the `input[type=file]` element. This functionality was an opaque action as far as the page's JavaScript was concerned, because the page couldn't see anything about the file selected, or interact with it in any meaningful way.

HTML5 gives us the `FileReader` API, which lets us take a reference to a local file, and read its contents directly into the web page.

To test if the browser supports the enhanced `FileReader` API, use the following feature-detect:

```
var history_support = typeof FileReader != "undefined";
```

We saw in [“Drag and Drop” on page 209](#) how to get a reference to local file(s) using the native drag and drop functionality. In a very similar way, we can now get a reference to local files selected by the user in a `input[type=file]` element:

```
<p>Pick an image file:</p>
<input type="file" id="file_selector" />

<script>
var file_selector = document.getElementById("file_selector");
file_selector.addEventListener("change", function(){
    var files_array = this.files;
    // now, you have a reference to the file(s) that the user selected.
    // Do something cool with them!
}, false);
</script>
```

Either way, once you have a reference to a local file, such as an image file, you can read the contents of that file using a `FileReader` instance:

```

function read_image_file(file) {
    var reader = new FileReader();
    reader.onload = function(e){
        var image_contents = e.target.result;
        // now you have the contents of the file!
    };
    reader.readAsDataURL(file);
}

```

Now that you have the file contents, in this case, as a *data URI* (base64-encoding of the file), you can display it in an `img` element. The code all put together looks like this:

```

<p>Pick an image file:</p>
<input type="file" id="file_selector" />

<script>
var file_selector = document.getElementById("file_selector");
file_selector.addEventListener("change", function(){
    var files_array = this.files;
    // we only allowed one file to be selected
    if (files_array[0].type.match(/image/)) { // it's an image file
        read_image_file(files_array[0]);
    }
}, false);

function read_image_file(file) {
    var reader = new FileReader();
    reader.onload = function(e){
        var image_contents = e.target.result;
        var img = document.createElement("img");
        img.src = image_contents;
        document.body.appendChild(img);
    };
    reader.readAsDataURL(file);
}
</script>

```



This code snippet assumes only one file being selected, but the `<input type="file">` element now supports the “multiple” attribute, which allows the user to select more than one file at a time. This is why we receive an array of file references, rather than a single file reference.

If you also want to let the user upload the image file they’ve selected, you simply need to send the file’s contents to the server via an XHR Ajax call:

```

<p>Pick an image file:</p>
<input type="file" id="file_selector" />
<input type="button" id="upload" value="Upload Image" disabled />

<script>
var file_selector = document.getElementById("file_selector");
file_selector.addEventListener("change", function(){
    var files_array = this.files;

```

```

// we only allowed one file to be selected
if (files_array[0].type.match(/image/)) { // it's an image file
    read_image_file(files_array[0]);

    file_selector.disabled = true; // disable the file selector now
    var upload = document.getElementById("upload");
    upload.disabled = false;
    upload.addEventListener("click", function(){
        upload_file(files_array[0]);
    }, false);
}
}, false);

function upload_file(file) {
    var xhr = new XMLHttpRequest();
    xhr.setRequestHeader("Content-Type", "multipart/form-data");
    xhr.setRequestHeader("X-File-Name", file.fileName);
    xhr.setRequestHeader("X-File-Size", file.fileSize);
    xhr.setRequestHeader("X-File-Type", file.type);
    xhr.open("GET", "image_upload.php");
    xhr.send(file);
}

function read_image_file(file) {
    var reader = new FileReader();
    reader.onload = function(e){
        var image_contents = e.target.result;
        var img = document.createElement("img");
        img.src = image_contents;
        document.body.appendChild(img);
    };
    reader.readAsDataURL(file);
}
</script>

```

Notice that you now have access to the file's name, size, and type, and so you send that data along to the server along with the file's contents. Other than that, we're not doing much extra here that's particularly HTML5'y—we're just using standard XHR to upload the file.

## Discussion

HTML5 gives us the `FileReader` API, so we can read a user's local file contents, and use those contents in the webpage.

The example above shows how to use those contents to display an image file's preview, or to send (aka, upload) those file contents to a server using Ajax. There are of course a variety of other things you may want to do with the file's contents.

For instance, the `FileReader` API provides a `readAsBinaryString(...)` method, which gives you a binary string representation of the file's contents. If you know the format of the file you are reading, you can perform various operations on this data.

As another example, if you put the image data into an `img` element (as shown above), then you could use what you learned in “[Web Sockets](#)” on page 218 to render that image to a `canvas` element, where you can then perform various color and geometric transformations (see “[History](#)” on page 222 and “[Local Files](#)” on page 226).

At this time, access to local files is restricted to read-only, and it must be initiated by a user action, such as dragging a file onto the webpage or selecting one or more files from the `input[type=file]` element. This is probably for the best, safety-wise, as allowing pages to write to the local file system, while cool, could be quite dangerous!

Also, keep in mind that local file access is still heavily evolving in browsers, and so it’s very important to test the functionality you want in your target browser environments, and to provide fallback behavior if it isn’t present or doesn’t work the way you need it to.

## See Also

For more information about interacting with local files from the webpage, see this MDC entry: [https://developer.mozilla.org/en/Using\\_files\\_from\\_web\\_applications](https://developer.mozilla.org/en/Using_files_from_web_applications).

