

Rapid Introduction to HTML, CSS, and JavaScript



with examples and
hands-on exercises

WEBUCATOR

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Class Files

Download the class files used in this manual at

<https://static.webucator.com/media/public/materials/classfiles/HCJ101-5.1.0.zip>.

Errata

Corrections to errors in the manual can be found at <https://www.webucator.com/books/errata/>.

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LESSON 1

A Quick Overview of Web Development

Topics Covered

- Client-side web development languages.
- Server-side web development languages.

Introduction

Learning HTML is the first step to becoming a web developer. But it is just one of several languages you will need to know to create websites and web applications. In this lesson, you will learn where HTML fits in the ecosystem of web development.



1.1. HTML is Part of a Team

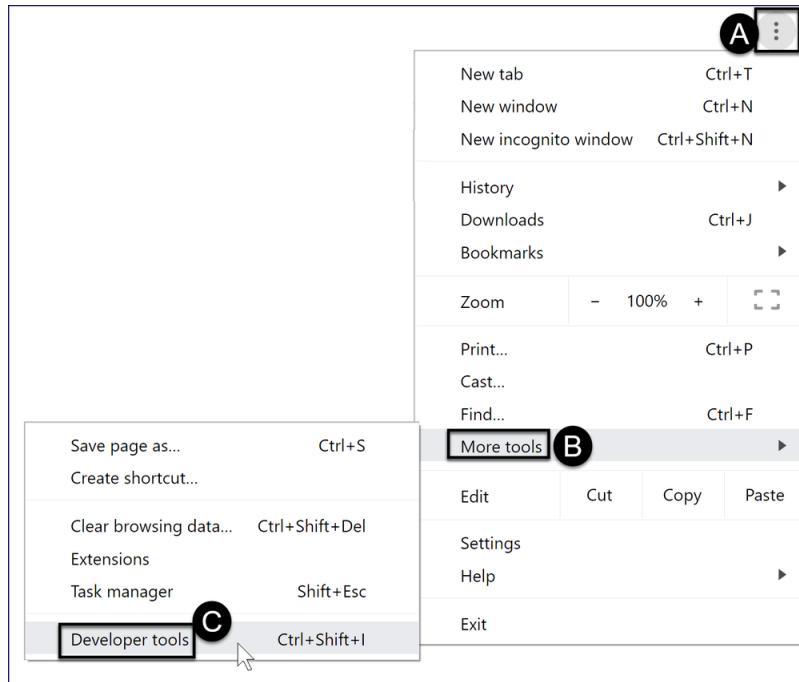
Before you get started writing HTML code, it's important to understand where HTML fits in the ecosystem of web development. Let's first consider what happens when you visit a website. When you type in a URL in the location bar of your browser (e.g., <https://www.runners-home.com>), the browser makes a request from the web server for a web page. If you don't specify the name of the file you want (e.g., `contact.html` or `about.html`), the web server will send a default page, which is most likely called `index.html`, `index.php`, `index.cfm`, or something similar. The web server returns that web page to the browser for display. The web page may include references to other files:

- Images to display on the page.
- Style sheets to add formatting to the page.
- Scripts to add interactivity to the page.

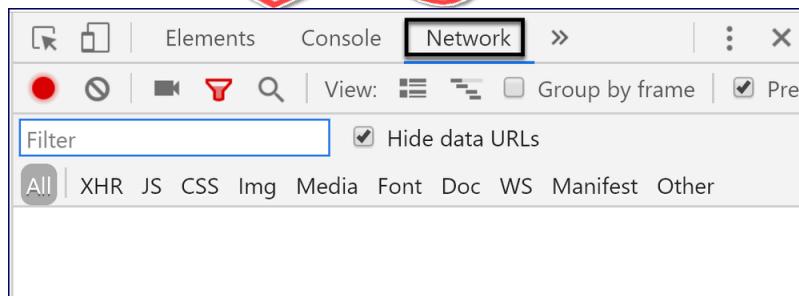
The browser will download these referenced files as well. To get a better feel for this, do the following in Google Chrome:

1. As illustrated below...
 - A. Click the three-vertical-dot icon in the upper right of Google Chrome:
 - B. Then select **More tools**.

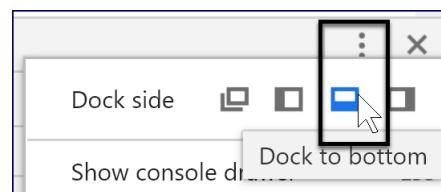
C. Then select **Developer tools**. This will open **Chrome's Developer tools**.



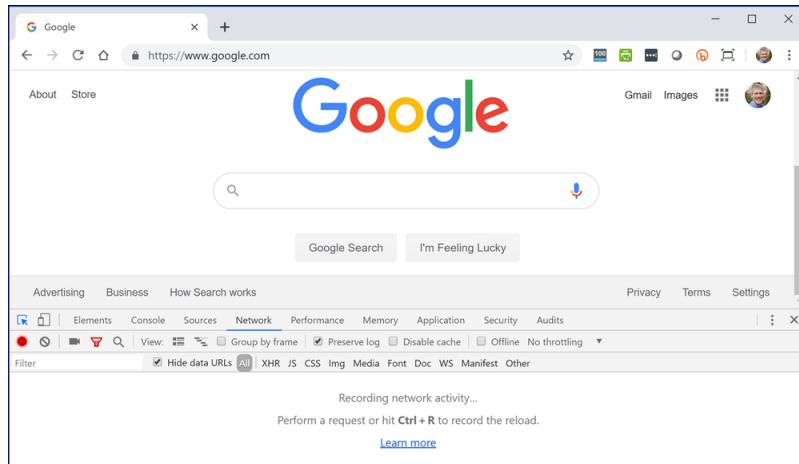
2. In **Developer tools**, select the **Network** tab:



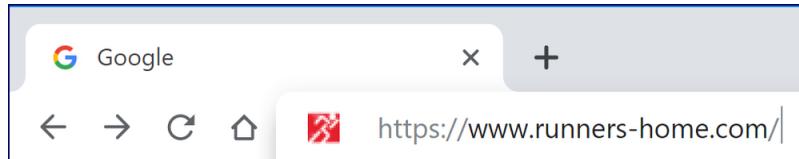
3. If **Developer tools** isn't docked on the bottom of the browser, move it to the bottom to make it easier to see the **Network** tab information:



Developer tools should now be at the bottom of the browser:



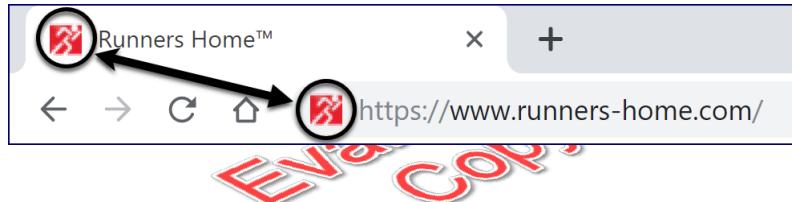
4. Now, in the **location bar** of your browser, enter `https://www.runners-home.com` and press **Enter**:



5. After the page loads, take a look at the **Network tab**. You should see something like this:

| Name | Status | Type | Initiator |
|----------------------|--------|------------|-----------|
| www.runners-home.com | 200 | document | Other |
| toggle.js | 200 | script | (index) |
| normalize.css | 200 | stylesheet | (index) |
| all.css | 200 | stylesheet | (index) |
| styles.css | 200 | stylesheet | (index) |
| home-styles.css | 200 | stylesheet | (index) |
| runners-home.png | 200 | png | (index) |
| runners.jpg | 200 | jpeg | (index) |
| tips-running.png | 200 | png | (index) |
| tips-health.png | 200 | png | (index) |
| fa-brands-400.woff2 | 200 | font | (index) |
| fa-solid-900.woff2 | 200 | font | (index) |

- A. `www.runners-home.com` – Although it doesn't specify the page, this represents the main page you requested: the HTML page (usually called `index`).
- B. `toggle.js` – A JavaScript page used for adding interactivity to the HTML page. Notice in the fourth column that the initiator for this page is `(index)`. That means that the HTML code instructed the browser to download this page.
- C. Style sheets ending with `.css` – CSS pages used for adding style and formatting to the HTML page. Like the JavaScript page, these pages were also requested by the HTML code.
- D. Images ending with `.png` and `.jpg` – Images to display on the page. The images were also requested by the HTML code.
- E. Font files ending with `.woff2` – Web fonts for adding custom fonts to your web page.
- F. Though not shown in the screenshot above, you may also see `favicon.ico` – An icon used to identify the website on the browser tab:



Note that `favicon.ico` only gets delivered when pages are sent from a web server. When you open files in a browser directly from your file system, the favicon will not show up.

As you can see, HTML, while essential, is just a piece of the puzzle. Web development involves a combination of client-side-programming and server-side-programming languages. We will now introduce the most common languages, but don't worry if you don't fully understand the role of each one. At this point, the most important takeaway is that HTML is just one of many languages used in web development.

*

1.2. Client-side Programming

Client-side programming involves writing code that is interpreted by a browser, such as Google Chrome or Safari, whether it be on your desktop or mobile device. The most common languages and technologies used in client-side programming are HTML, Cascading Style Sheets (CSS), and JavaScript.

❖ 1.2.1. HTML

Hypertext Markup Language (HTML) is the language behind most web pages. The language is made up of elements that describe the structure of the content on a web page.

❖ 1.2.2. Cascading Style Sheets

Cascading Style Sheets (CSS) are used in HTML pages to format and lay out the content. CSS rules defining color, size, positioning, and other display aspects of elements are mixed within the HTML code or in linked external style sheets.

❖ 1.2.3. JavaScript¹

JavaScript is used to make HTML pages more dynamic and interactive. It can be used to validate forms, pop up new windows, create audio and video controls, and create dynamic effects such as drop-down menus and modal dialogs.

❖ 1.2.4. Ajax

The term *Ajax* was originally a pseudo-acronym for “Asynchronous JavaScript and XML,” but is now used much more broadly to cover all methods of communicating with a server using JavaScript.

The main purpose of Ajax is to provide a simple and standard means for a web page to communicate with the server without a complete page refresh.

❖ 1.2.5. JavaScript Frameworks

JavaScript frameworks are frameworks written in JavaScript that create a different approach to web application design. Popular frameworks include Angular (<https://angular.io>), React (<https://reactjs.org>), Vue.js (<https://vuejs.org>), and jQuery (<https://jquery.com>). You should learn JavaScript before beginning to work with a JavaScript framework.

❖ 1.2.6. CSS Frameworks

CSS frameworks are frameworks that allow you to quickly design HTML pages with a predefined set of CSS classes. The most popular CSS framework is Bootstrap (<https://getbootstrap.com/>), which comes with a library of stylish components that you can easily incorporate into your website.

1. The word “JavaScript” is a trademark of Oracle. Microsoft’s version of this language is called JScript.

Tailwind CSS (<https://tailwindcss.com/>) is a newer CSS framework that allows for more customization, but requires a better understanding of CSS.



1.3. Server-side Programming

Server-side programming involves writing code that connects web pages with databases, XML pages, email servers, file systems, and other systems and software accessible from the web server. The most common server-side languages and programming frameworks are PHP, Java Enterprise Edition, ASP.NET, ColdFusion, Node.js, and Python.

❖ 1.3.1. PHP

PHP (<https://www.php.net>) is open source. It is the language behind WordPress and has long been a popular alternative to proprietary languages such as ColdFusion and ASP.NET. PHP is lightweight and relatively simple to learn.

❖ 1.3.2. Java EE

Java EE (<https://docs.oracle.com/javaee>) is used in large web projects. With its power and robustness comes a steep learning curve.

❖ 1.3.3. ASP.NET

Microsoft's ASP.NET (<https://docs.microsoft.com/aspnet>) is not a language, but a framework for writing websites and software. ASP.NET pages can be written in many languages, but the most popular are C# (pronounced C-sharp) and Visual Basic .NET (VB.NET).

❖ 1.3.4. ColdFusion

ColdFusion (<https://coldfusion.adobe.com>), created by Allaire (now owned by Adobe), is arguably the simplest of all server-side languages. It is tag-based, which makes it look a lot like HTML and easier for client-side programmers to understand than some of the other choices.

❖ 1.3.5. Node.js

Node.js (<https://nodejs.org>) is a JavaScript framework that runs on the server, allowing developers to use JavaScript for server-side scripting as well as client-side scripting.

❖ 1.3.6. Python

Python (<https://www.python.org>) has been a popular open-source programming language for a long time. There are many web frameworks based on Python, the most popular of which is Django (<https://www.djangoproject.com>).

Conclusion

This lesson has provided a general overview of the different languages and frameworks commonly used in web development. Again, don't worry if you don't remember all the different technologies and their specific roles. Take it one step at a time. The first step is to learn HTML.

LESSON 2

Introduction to HTML

Topics Covered

- Creating a simple HTML page.
- Elements and attributes.
- The skeleton of an HTML document.
- Whitespace.
- Special characters.
- History of HTML.

Evaluation
Copy

Introduction

You're likely learning HTML because you have dreams of creating a website; perhaps like one you have seen or perhaps like no other that's yet been created. You have the dream, now it's time to start building the foundation.

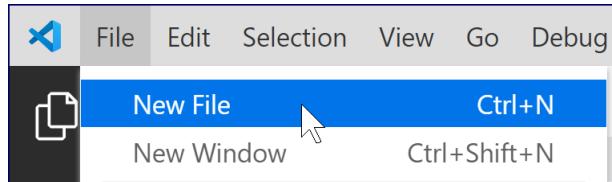
We will begin with a simple exercise.

Exercise 1: A Simple HTML Document

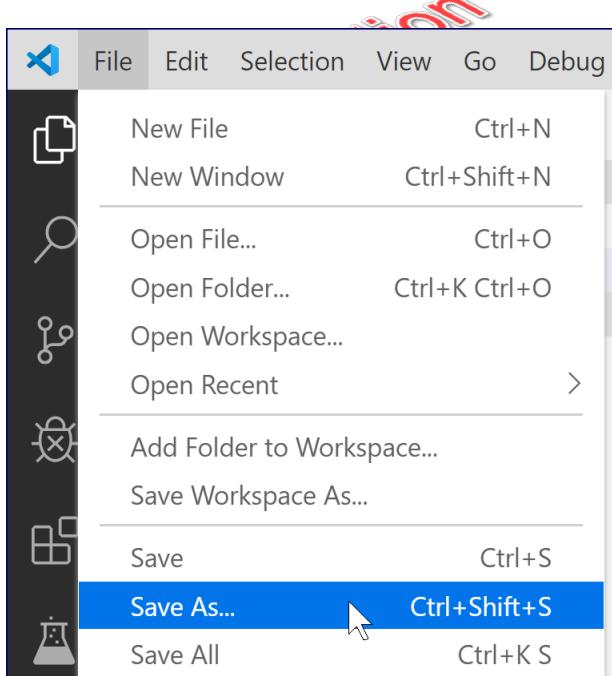
 5 to 15 minutes

In this exercise, you will create your first HTML document by simply copying some code. The purpose is to give you some sense of the structure of an HTML document.

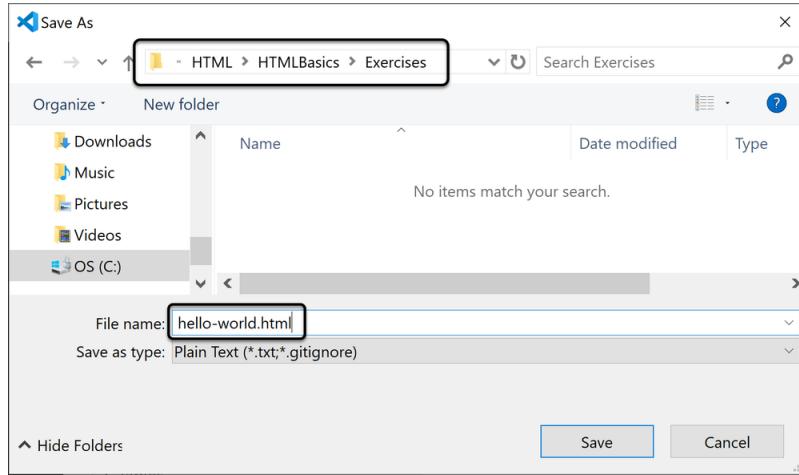
1. Create a new file in Visual Studio Code:



2. To save the file, select **File > Save As...**



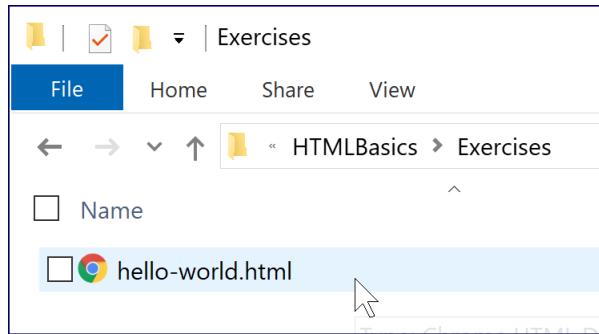
3. Save the file as `hello-world.html` in the `HTMLBasics/Exercises` folder:



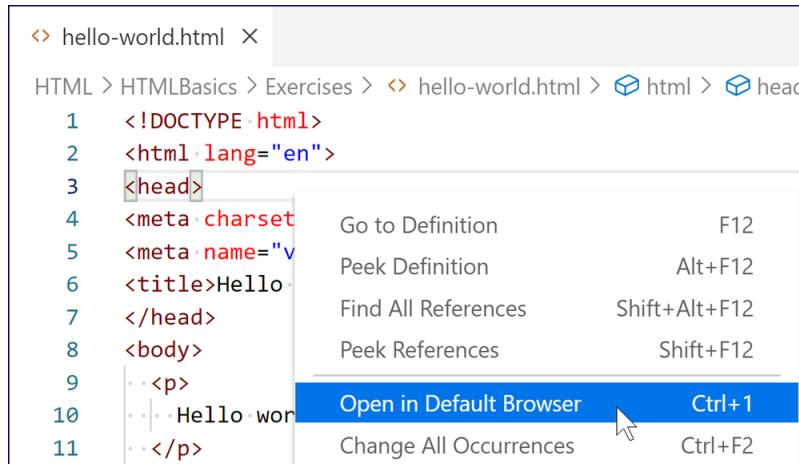
- Type the following exactly as shown:

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1">
<title>Hello world!</title>
</head>
<body>
    <p>Hello world!</p>
</body>
</html>
```

- Save the file again and then open it in your browser either by navigating to the file in your folder system and double-clicking it:

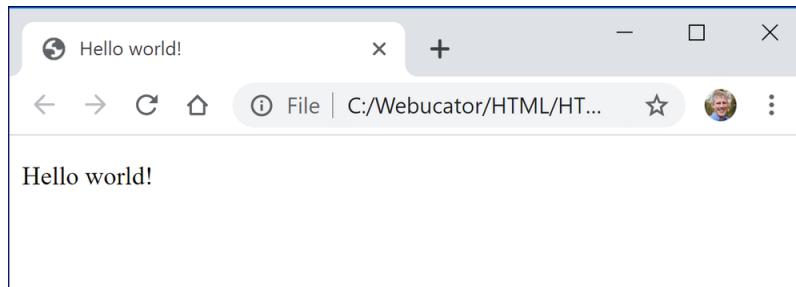


Or by right-clicking the file in Visual Studio Code and selecting **Open in Default Browser**, which you should have added when setting up Visual Studio Code:



```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="v
<title>Hello world!
```

The page should appear as follows:



Solution: HTMLBasics/Solutions/hello-world.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Hello world!</title>
7.  </head>
8.  <body>
9.    <p>Hello world!</p>
10. </body>
11. </html>
```



2.1. HTML Elements, Attributes, and Comments

HTML *elements* describe the structure and content of a web page. *Tags* are used to indicate the beginning and end of elements. The syntax is as follows:

```
<tagname>Element content</tagname>
```

❖ 2.1.1. Attributes

Tags often have *attributes* for further defining the element. Attributes usually come in name-value pairs.

Note that attributes only appear in the opening tag, like so:

```
<tagname att1="value" att2="value">Element content</tagname>
```

There are some attributes that do not need to take a value. You can think of them as being “on” when the attribute is present and “off” when it is not. For example:

```
<tagname att>Element content</tagname>
```

The order of attributes is not important.

Evaluation
Copy

❖ 2.1.2. Empty vs. Container Tags

The tags shown above are called *container* tags because they have both an opening and closing tag with content contained between them. Tags that do not contain content are called *empty* tags. The syntax is as follows:

```
<tagname>
```

or

```
<tagname att1="value" att2="value">
```

Shortcut Close

Empty tags may also be written as follows:

```
<tagname />
```

or

```
<tagname att1="value" att2="value" />
```

The forward slash (/) at the end, just before the close angle bracket (>), explicitly indicates that this tag is closed. In general, it is not necessary to use this shortcut close, but it also doesn't cause any harm. Our only recommendation is that if you use it, use it consistently.

❖ 2.1.3. Blocks and Inline Elements

Block-level Elements

Block-level elements are elements that separate a block of content. For example, a paragraph (`<p>`) element is a block-level element. Other block-level elements include:

1. Lists (`` and ``)
2. Tables (`<table>`)
3. Forms (`<form>`)
4. Divs (`<div>`)

Evaluation
Copy

Inline Elements

Inline elements are elements that affect only snippets of content and do not block off a section of a page. Examples of inline elements include:

1. Links (`<a>`)
2. Images (``)
3. Form elements (`<input>`, `<button>`, `<select>`, `<textarea>`, etc.)
4. Phrase elements (``, ``, `<code>`, etc.)
5. Spans (``) – wraps text without giving it any special meaning. Meaning and style can be applied through its attributes.

You will learn what most of these elements do in upcoming lessons.

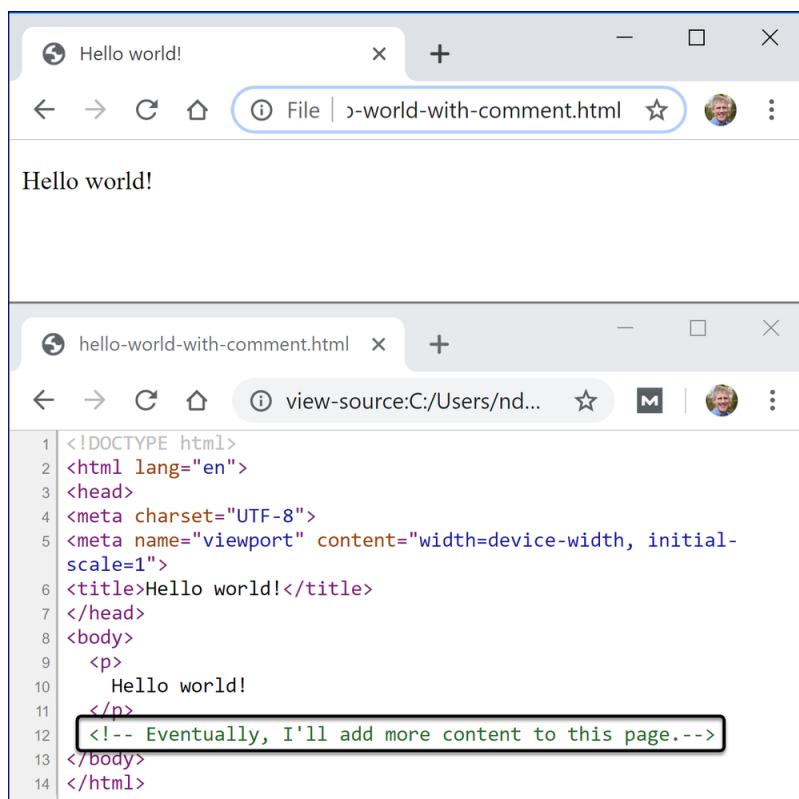
❖ 2.1.4. Comments

HTML comments are enclosed in `<!--` and `-->`.

For example:

```
<!-- This is an HTML comment -->
```

Commented content will not show up on the web page. It is meant for developers' eyes only. However, as illustrated in the following screenshot, users can see comments by viewing the source of the page.² So don't put anything in your comments that you wouldn't want your site visitors to read.



The screenshot shows two windows side-by-side. The top window is a browser displaying the text "Hello world!". The bottom window is a code editor showing the source code for "hello-world-with-comment.html". The code is as follows:

```
1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4 <meta charset="UTF-8">
5 <meta name="viewport" content="width=device-width, initial-
scale=1">
6 <title>Hello world!</title>
7 </head>
8 <body>
9   <p>
10     Hello world!
11   </p>
12   <!-- Eventually, I'll add more content to this page.-->
13 </body>
14 </html>
```

The line `<!-- Eventually, I'll add more content to this page.-->` is highlighted with a black border.

Comments are generally used for one of two purposes:

1. To write helpful notes about the code; for example, why something is written in a specific way.

2. You'll learn how to view the source of a page shortly.

- To comment out some code that is not currently needed, but may be used sometime in the future.

*

2.2. The HTML Skeleton

At its simplest, an HTML page contains what can be thought of as a skeleton: the main structure of the page. It looks like this:

Demo 2.1: **HTMLBasics/Demos/skeleton.html**

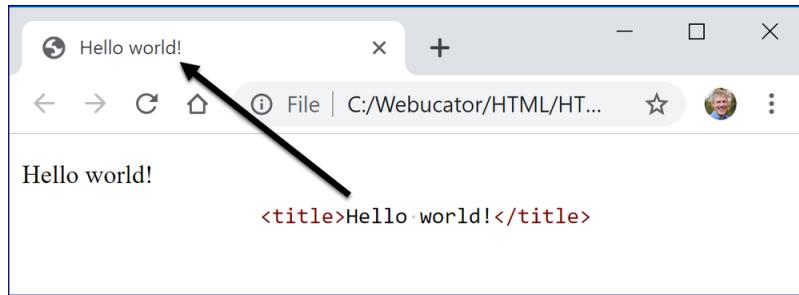
```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title></title>
7.  </head>
8.  <body>
9.  <!--
10.    Content that appears on the page goes in the body
11.    (but I won't show up because I'm in a comment).
12.  -->
13.  </body>
14. </html>
```

Evaluation
Copy

❖ 2.2.1. The head Element

The `head` element (`<head>`) contains content that is not displayed on the page itself. Some of the elements commonly found in the `head` are:

- Title of the page (`<title>`). Browsers typically show the title in the “title bar” at the top of the browser window:



2. Meta tags (`<meta>`), which contain descriptive information about the page.
3. Script blocks (`<script>`), which contain JavaScript code for adding functionality and interactivity to a page.
4. Style blocks (`<style>`), which contain Cascading Style Sheet rules for formatting a page.
5. References or links to external style sheets (`<link>`).

Here is an example head element:

```
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1">
<link href="styles.css" ref="stylesheet">
<script src="script.js"></script>
<title>Dummy title</title>
</head>
```

A large red watermark reading "Evaluation Copy" is overlaid across the code block.

Don't worry about the `<link>` and `<script>` tags. You'll learn about those when you learn CSS and JavaScript. For now, it is enough to know that HTML pages can reference CSS and JavaScript pages.

❖ 2.2.2. The body Element

The body element (`<body>`) contains all of the content that appears on the page itself. Tags that can be placed within the `<body>` tag will be covered thoroughly throughout these lessons.

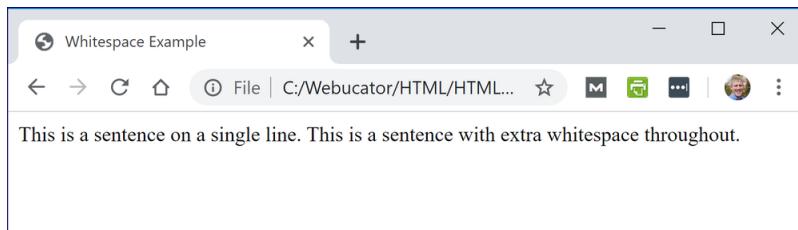
❖ 2.2.3. Whitespace

Extra whitespace is ignored in HTML. This means that all hard returns, tabs, and multiple spaces are condensed into a single space for display purposes. Review the following demo:

Demo 2.2: HTMLBasics/Demos/whitespace.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Whitespace Example</title>
7.  </head>
8.  <body>
9.  This is a sentence on a single line.
10.
11.  This
12.      is
13.          a
14.              sentence with
15.                  extra whitespace
16.                      throughout.
17.
18.  </body>
19. </html>
```

Open `HTMLBasics/Demos/whitespace.html` in your browser. You will see that the two sentences in the code above will be rendered in exactly the same way. Notice that all extra whitespace is ignored:



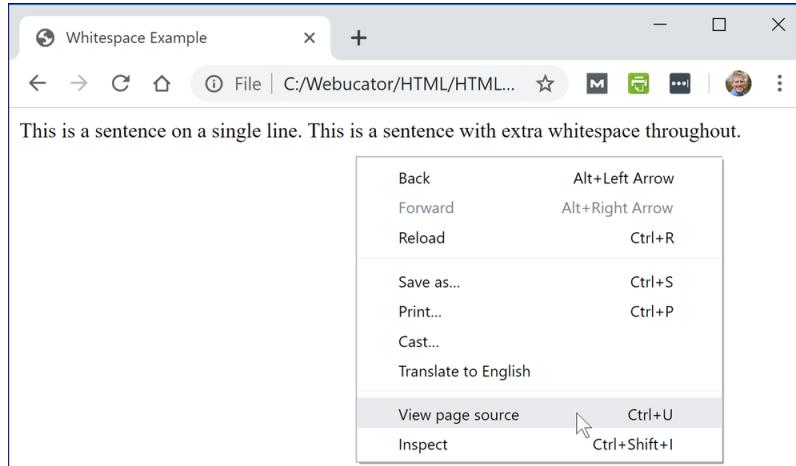
Why is extra whitespace ignored?

Browsers ignore extra whitespace so that web developers can use hard returns, spaces, and tabs to make their code readable. For example, we like to limit the length of one line of HTML code to 120 characters as this makes it easier to read the code. But we don't want text that we send to the browser to also be limited to 120-character lines.

*

2.3. Viewing the Page Source

Most browsers will let you view the source of an HTML page. This is a useful way to see what the browser sees. In Google Chrome, you can do this by right-clicking the page and selecting **View Page Source**:



You will see the source of the page you created.

A screenshot of a Google Chrome window titled "Whitespace Example" with the tab name "whitespace.html". The address bar shows "view-source:C:/Webucator/...". The main content area displays the raw HTML source code. The code includes the DOCTYPE declaration, HTML and head tags, meta charset and viewport tags, a title, and a body containing two sentences. The body text is identical to the content shown in the first screenshot but is displayed with visible whitespace (newlines and spaces) between words and after punctuation marks.

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1">
<title>Whitespace Example</title>
</head>
<body>
This is a sentence on a single line.

This
is
a
sentence with
extra whitespace
throughout.

</body>
</html>
```

This demonstrates that Chrome does see all the whitespace in the page source. But it condenses it when it presents the web page.



2.4. Special Characters

Special characters (e.g., characters that do not show up on your keyboard) can be added to HTML pages using entity names and numbers. For example, a copyright symbol (©) can be added using © or ©. The following table shows some of the more common character references:³

HTML Entities

| DESCRIPTION | NUMBER | NAME | SYMBOL |
|------------------------------------|---------|----------|--------|
| Quotation mark | " | " | " |
| Single quotation mark (apostrophe) | ' | ' | ' |
| Ampersand | & | & | & |
| Less than | < | < | < |
| Greater than | > | > | > |
| Non-breaking space | | | |
| Cent sign | ¢ | ¢ | ¢ |
| Pound sign | £ | £ | £ |
| Yen sign | ¥ | ¥ | ¥ |
| Euro sign | € | € | € |
| Copyright | © | © | © |
| Registered trademark | ® | ® | ® |
| Trademark | ™ | ™ | ™ |
| Inverted question mark | ¿ | ¿ | ¿ |
| Inverted exclamation mark | ¡ | ¡ | ¡ |
| Fraction: one-fourth | ¼ | ¼ | ¼ |
| Fraction: one-half | ½ | ½ | ½ |
| Fraction: three-fourths | ¾ | ¾ | ¾ |
| En dash | – | – | – |
| Em dash | — | — | — |
| Dagger | † | † | † |
| Horizontal ellipsis | … | … | ... |



3. See <https://html.spec.whatwg.org/multipage/named-characters.html#named-character-references> for the official list of HTML entities.

2.5. History of HTML

HTML has a long history and several versions:

1. HTML was invented in the early 1990s.
2. In 1996, the World Wide Web Consortium (W3C)⁴ began maintaining the HTML specification. At that point, HTML was already on version 2.0.
3. HTML 3.2 and HTML 4.0 were both released in 1997.
4. XHTML, a separate XML version of HTML, was released in 2000.
5. HTML5 was released in 2014 and updated to HTML 5.1 (now with a space before the 5) in 2016. As of this writing, it is in version 5.3.
6. For a while, two separate groups, the W3C and WHATWG⁵ managed separate HTML specifications, with at least a little tension between the two groups⁶. In 2019, the W3C gave full control of the HTML standard to WHATWG.

❖ 2.5.1. HTML5 / HTML 5

You may hear a lot about HTML5 or HTML 5. For a few years, the distinction between HTML 4 and HTML 5 was important. Today, you can simply think of everything as just HTML. The HTML you use will be determined more by what modern browsers support than by what the specifications specify.

❖ 2.5.2. What This Means for You

As a web developer, you don't need to be too concerned with this history. The question is: **what can you do today?** The best, most developer-friendly online reference is kept by Mozilla at <https://developer.mozilla.org/en-US/docs/Web/HTML/Reference>.

Because people have been writing HTML for a long time, web pages exist that use deprecated (phased out) tags and outdated techniques, such as using `color` and `bgcolor` attributes instead of CSS to add color to pages. Modern browsers tend to be backward compatible, but you should avoid using any deprecated tags and attributes.

4. <https://www.w3.org/standards/techs/html>

5. <https://html.spec.whatwg.org>

6. https://en.wikipedia.org/wiki/HTML5#W3C_and_WHATWG_conflict

To indicate that you are using the latest version of HTML, you should use the following DOCTYPE at the beginning of every HTML document:

```
<!DOCTYPE html>
```

This DOCTYPE is completely backward compatible and will make all browsers work in “standards mode,” which is almost definitely what you want.

Although they are not required, you should generally use the following `<meta>` tags:

```
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1">
```

The first specifies the character set and the second makes web pages adjust for different screen sizes.

The opening of an HTML page should look like this (assuming your page is in English):

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1">
```



2.6. The lang Attribute

The `lang` attribute is used to tell the browser and other user agents⁷ the language contained within an element. While it is not required, the W3C recommends that `lang` be included in the `<html>` tag of all HTML documents, like so:

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

According to the W3C,⁸ the `lang` attribute is helpful in:

7. A user agent is software that acts on behalf of the user. When used in web development, the term refers to a web browser or any other software used to request a web page from the server.

8. <https://www.w3.org/International/questions/qa-html-language-declarations>

1. Assisting search engines.
2. Assisting speech synthesizers.
3. Helping a user agent select glyph variants for high-quality typography.
4. Helping a user agent choose a set of quotation marks.
5. Helping a user agent make decisions about hyphenation, ligatures, and spacing.
6. Assisting spell checkers and grammar checkers.

If a portion of the page is written in a different language, you can wrap that portion in a tag that includes the `lang` attribute, like this:

```
<span lang="fr">Bonjour, mon ami!</span>
```

A smart screen reader⁹ could use that information to properly pronounce the French.

Conclusion

In this lesson, you have learned the basics of HTML. You should understand how an HTML page is structured and understand the basic syntax of HTML tags. In addition, you have learned some of the history of HTML.

9. Screen readers make it possible for visually impaired people to read web pages and other computer-based content. A widely used screen reader is JAWS from Freedom Scientific (<https://www.freedomscientific.com>).

LESSON 3

Paragraphs, Headings, and Text

Topics Covered

- Paragraphs.
- Headings.
- Breaks and horizontal rules.
- Quoted text.
- Preformatted text.
- Phrase elements.

Evaluation
Copy

Introduction

This lesson discusses how to properly mark up text. With just a few exceptions, it does not discuss how to change the formatting or display of these elements. That is a task for CSS.



3.1. Paragraphs

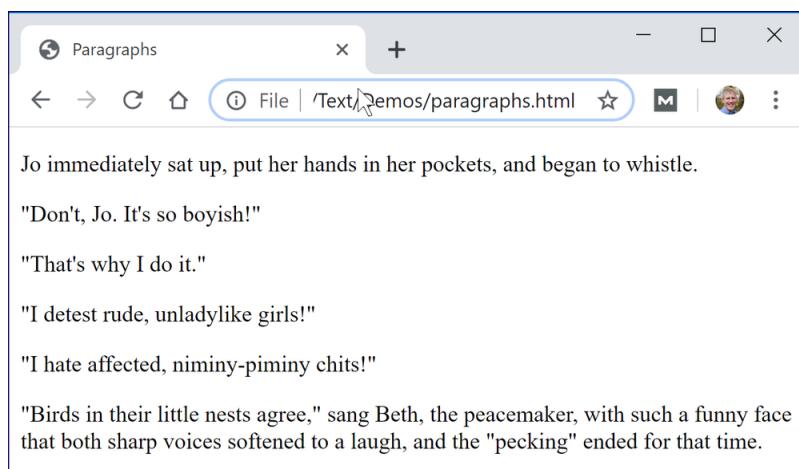
Paragraph text should be contained in `<p>` tags as shown in the following example:

Demo 3.1: Text/Demos/paragraphs.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Paragraphs</title>
7.  </head>
8.  <body>
9.    <!-- From Little Women by Louisa May Alcott-->
10.   <p>Jo immediately sat up, put her hands in her pockets,
11.     and began to whistle.</p>
12.   <p>"Don't, Jo. It's so boyish!"</p>
13.   <p>"That's why I do it."</p>
14.   <p>"I detest rude, unladylike girls!"</p>
15.   <p>"I hate affected, niminy-piminy chits!"</p>
16.   <p>"Birds in their little nests agree," sang Beth, the peacemaker,
17.     with such a funny face that both sharp voices softened to a laugh,
18.     and the "pecking" ended for that time.</p>
19. </body>
20. </html>
```

Evaluation
Copy

This page will be rendered as follows:



*

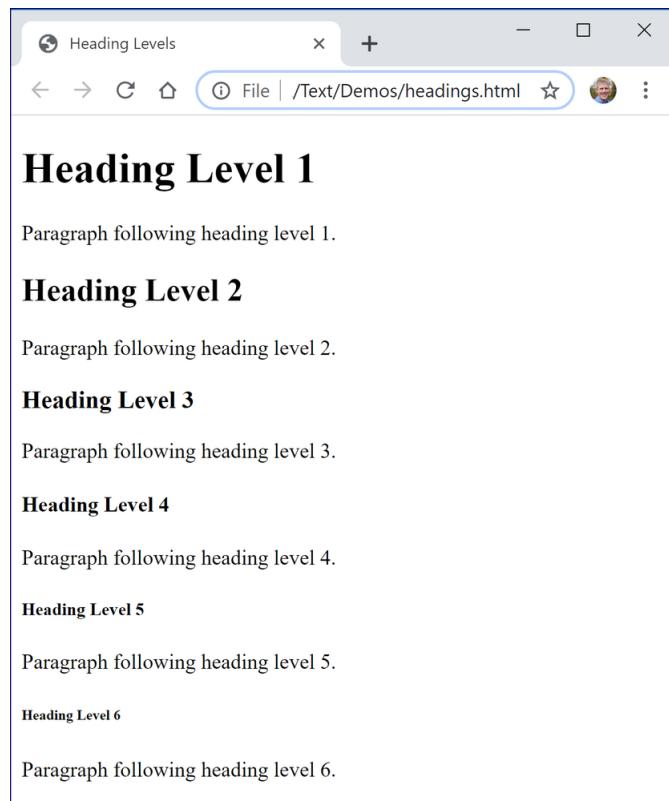
3.2. Heading Levels

HTML supports six levels of heading. The tags are `<h1>`, `<h2>`, `<h3>`, `<h4>`, `<h5>`, and `<h6>`, descending in importance from `<h1>` to `<h6>`. Headings are block-level elements. Examine the following code:

Demo 3.2: Text/Demos/headings.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Heading Levels</title>
7.  </head>
8.  <body>
9.    <h1>Heading Level 1</h1>
10.   <p>Paragraph following heading level 1.</p>
11.    <h2>Heading Level 2</h2>
12.    <p>Paragraph following heading level 2.</p>
13.    <h3>Heading Level 3</h3>
14.    <p>Paragraph following heading level 3.</p>
15.    <h4>Heading Level 4</h4>
16.    <p>Paragraph following heading level 4.</p>
17.    <h5>Heading Level 5</h5>
18.    <p>Paragraph following heading level 5.</p>
19.    <h6>Heading Level 6</h6>
20.    <p>Paragraph following heading level 6.</p>
21.  </body>
22. </html>
```

The following screenshot shows how they are formatted by default:



Evaluation Copy

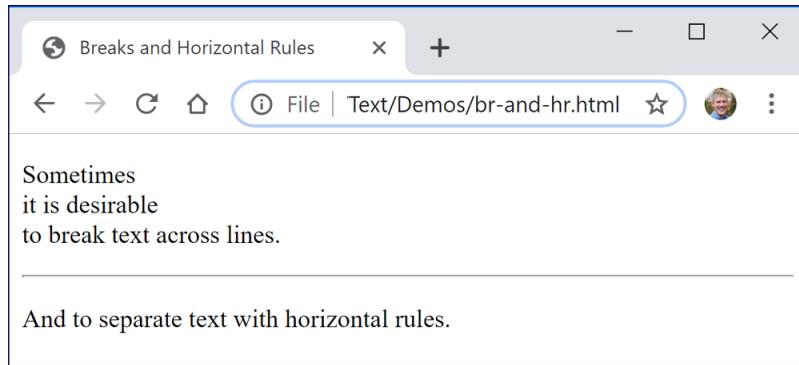
3.3. Breaks and Horizontal Rules

The `
` tag forces a line break. The `<hr>` tag creates a horizontal rule across the page. The following code shows how they are used:

Demo 3.3: Text/Demos/br-and-hr.html

```
-----Lines 1 through 7 Omitted-----
8.  <body>
9.    <p>Sometimes<br>it is desirable<br>to break text across lines.</p>
10.   <hr>
11.   <p>And to separate text with horizontal rules.</p>
12.  </body>
-----Line 13 Omitted-----
```

The following screenshot shows how they appear by default:



Notice that the `
` and `<hr>` tags are both *empty* tags, meaning that they do not contain any content, and therefore, do not have a corresponding closing tag.

*

3.4. The `div` Element

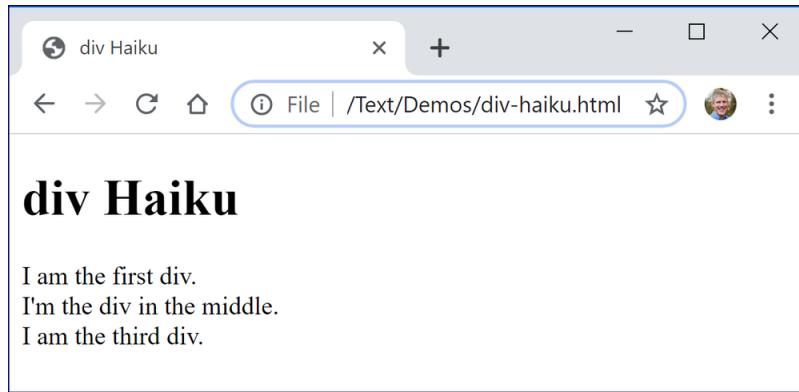
The `div` element (`<div>`) is used to create a content **division**. That is, it divides a segment of content from the surrounding content. Visually, this results in placing the content on its own block, similar in effect to putting a `
` tag before and after the content.

The following demo shows how `div` elements work:

Demo 3.4: Text/Demos/div-haiku.html

```
-----Lines 1 through 7 Omitted-----
8.  <body>
9.    <h1>div Haiku</h1>
10.   <div>I am the first div.</div>
11.   <div>I'm the div in the middle.</div>
12.   <div>I am the third div.</div>
13. </body>
-----Line 14 Omitted-----
```

The following screenshot shows how this will appear in the browser:

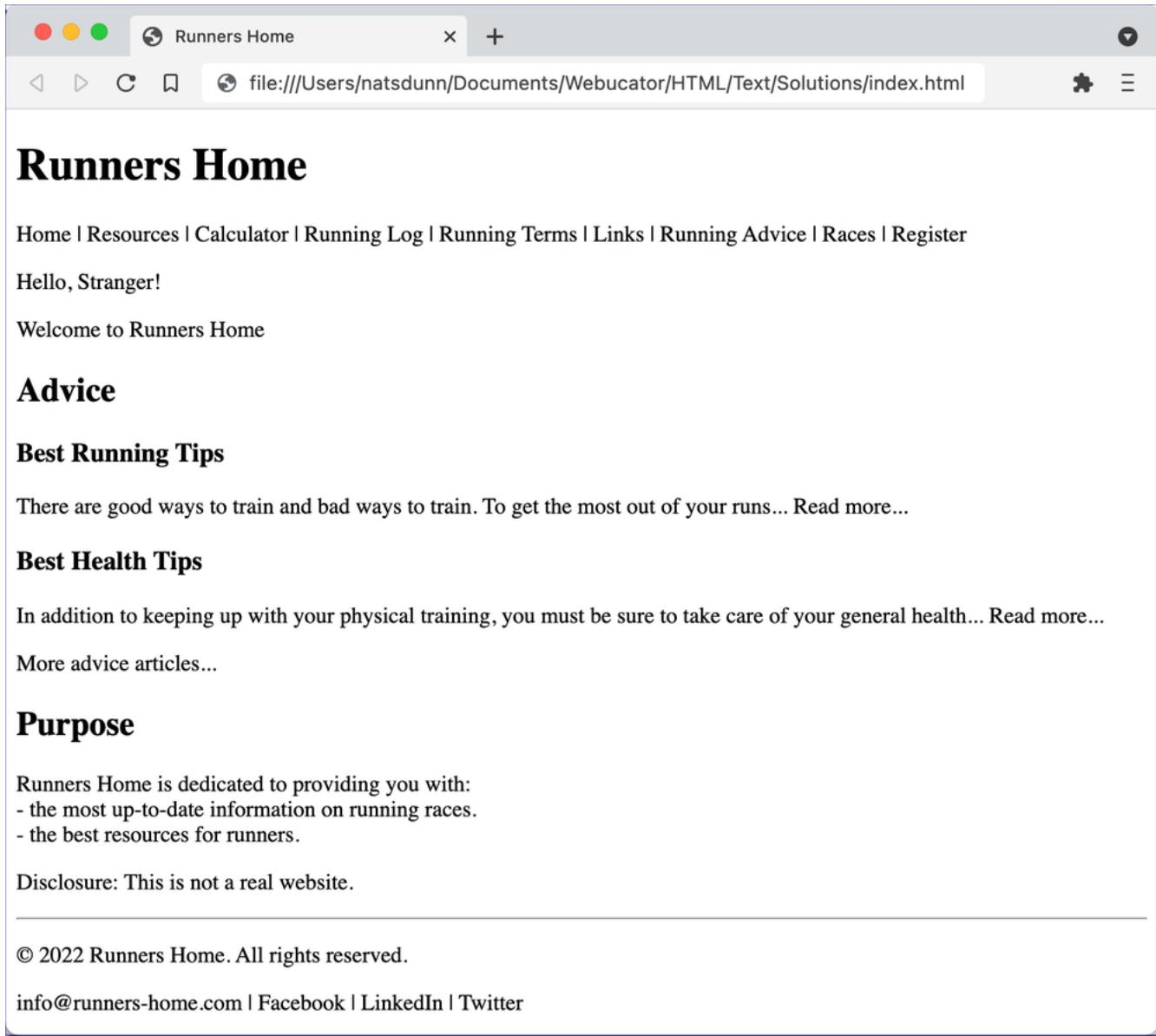


While the preceding demo illustrates how the `div` element works, it is more commonly used to separate larger blocks of content. You will learn more about this in the Sectioning a Web Page lesson (see page ?).

Exercise 2: Creating an HTML Page

 15 to 25 minutes

In this exercise, you will create an HTML page from scratch. It should look like this:



The screenshot shows a web browser window with the title "Runners Home". The address bar displays "file:///Users/natsdunn/Documents/Webucator/HTML/Text/Solutions/index.html". The main content area of the browser shows the following HTML code:

```
<html>
  <head>
    <title>Runners Home</title>
  </head>
  <body>
    <nav>
      <a href="#">Home | <a href="#">Resources | <a href="#">Calculator | <a href="#">Running Log | <a href="#">Running Terms | <a href="#">Links | <a href="#">Running Advice | <a href="#">Races | <a href="#">Register
    </nav>
    <h1>Runners Home</h1>
    <h2>Hello, Stranger!</h2>
    <p>Welcome to Runners Home</p>
    <h2>Advice</h2>
    <h3>Best Running Tips</h3>
    <p>There are good ways to train and bad ways to train. To get the most out of your runs...<a href="#">Read more...Read more...

At the bottom of the browser window, there is a footer with copyright information and social media links:



© 2022 Runners Home. All rights reserved.  
info@runners-home.com | Facebook | LinkedIn | Twitter


```

1. Create a new page in Visual Studio Code and save it as `index.html` in the `Text/Exercises` directory.
2. Write code to make the page look like the one in the screenshot above.

3. Save your work and open your new page in a browser to test it.

Challenge

Use special characters instead of the dashes to make more interesting bullets. Try •

Solution: Text/Solutions/index.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Runners Home</title>
7.  </head>
8.  <body>
9.  <h1>Runners Home</h1>
10. <div>
11.   Home | Resources | Calculator | Running Log | Running Terms |
12.   Links | Running Advice | Races | Register
13. </div>
14. <p>Hello, Stranger!</p>
15. <p>Welcome to Runners Home</p>
16. <h2>Advice</h2>
17. <h3>Best Running Tips</h3>
18. <p>There are good ways to train and bad ways to train. To get
19.   the most out of your runs... Read more...</p>
20. <h3>Best Health Tips</h3>
21. <p>In addition to keeping up with your physical training, you
22.   must be sure to take care of your general health...
23.   Read more...</p>
24. <p>More advice articles...</p>
25. <h2>Purpose</h2>
26. <p>Runners Home is dedicated to providing you with:<br>
27.   - the most up-to-date information on running races.<br>
28.   - the best resources for runners.
29. </p>
30. <p>Disclosure: This is not a real website.</p>
31. <hr>
32. <p>&copy; 2022 Runners Home. All rights reserved.</p>
33. <div>
34.   info@runners-home.com |
35.   Facebook |
36.   LinkedIn |
37.   Twitter
38. </div>
39. </body>
40. </html>
```

Challenge Solution: Text/Solutions/index-challenge.html

-----Lines 1 through 25 Omitted-----

26. <p>Runners Home is dedicated to providing you with:

27. • the most up-to-date information on running races.

28. • the best resources for runners.
29. </p>

-----Lines 30 through 40 Omitted-----

3.5. Quoted Text

*Evaluation
Copy**

The `<blockquote>` and `<q>` tags are used to designate quoted text. Both elements can take the `cite` attribute, which is used to reference the source. The value of the `cite` attribute, which is used to point to a URL with information about the quote, will not be visible on the page by default, but could be made accessible using JavaScript.

`blockquote` is a block-level element, while `q` is an inline element. See the following example:

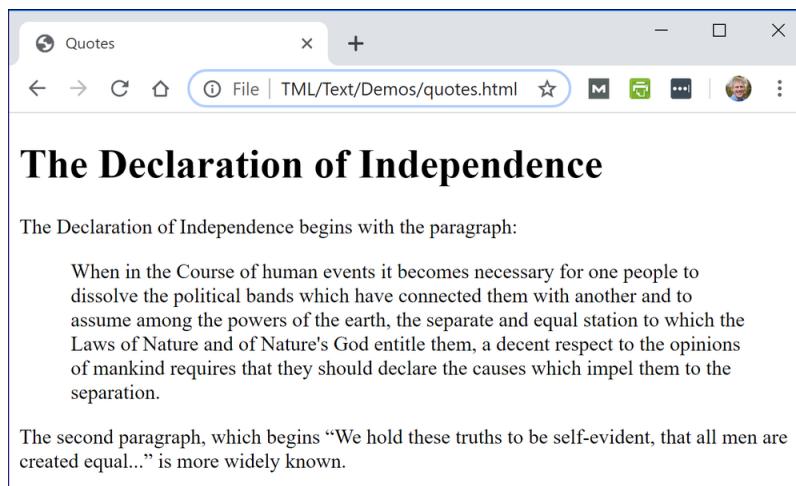
Demo 3.5: Text/Demos/quotes.html

```
-----Lines 1 through 7 Omitted-----  
8. <body>  
9.   <h1>The Declaration of Independence</h1>  
10.  <p>The Declaration of Independence begins with the paragraph:</p>  
11.  <blockquote  
12.    cite="https://www.ushistory.org/declaration/document/index.html">  
13.    <p>When in the Course of human events it becomes necessary for one  
14.      people to dissolve the political bands which have connected them  
15.      with another and to assume among the powers of the earth, the  
16.      separate and equal station to which the Laws of Nature and of  
17.      Nature's God entitle them, a decent respect to the opinions of  
18.      mankind requires that they should declare the causes which impel  
19.      them to the separation.</p>  
20.  </blockquote>  
21.  
22.  <p>The second paragraph, which begins  
23.  <q cite="https://www.ushistory.org/declaration/document/index.html">We  
24.  hold these truths to be self-evident, that all men are created  
25.  equal...</q> is more widely known.</p>  
26. </body>
```

-----Line 27 Omitted-----

Evaluation Copy

Most browsers add margins to blockquotes on both the left and right and wrap text nested in `<q>` tags with quotes. Google Chrome renders this page as follows:



Some notes:

1. Modern browsers don't do anything visual with the `cite` attribute.

2. Blockquotes should **not** be used for formatting purposes. If you want to add margins around an element, you should use Cascading Style Sheets (CSS).
 3. Blockquotes cannot be contained within paragraphs.
 4. Blockquotes cannot have text as a direct child. Usually, blockquotes contain paragraphs (**<p>** tags).
-



3.6. Preformatted Text

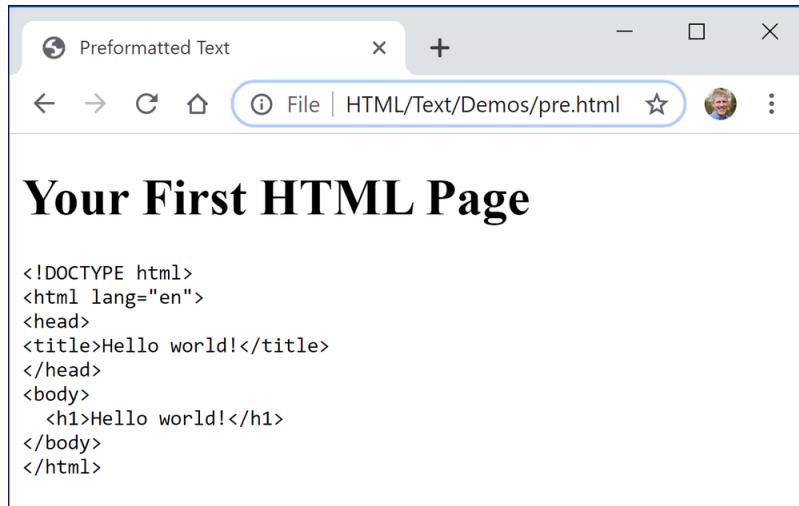
Occasionally, it is desirable to output content as it is laid out in the code, *whitespace and all*. The **<pre>** tag is used for this purpose. It is often used in online coding tutorials so that the whitespace shown in the tutorial reflects how it would appear in the document it represents. The following code shows how **<pre>** is used.

Demo 3.6: Text/Demos/pre.html



```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Preformatted Text</title>
7.  </head>
8.  <body>
9.  <h1>Your First HTML Page</h1>
10. <pre>
11. &lt;!DOCTYPE html&gt;
12. &lt;html lang="en"&gt;
13. &lt;head&gt;
14. &lt;title&gt;Hello world!&lt;/title&gt;
15. &lt;/head&gt;
16. &lt;body&gt;
17.   &lt;h1&gt;Hello world!&lt;/h1&gt;
18. &lt;/body&gt;
19. &lt;/html&gt;
20. </pre>
21. </body>
22. </html>
```

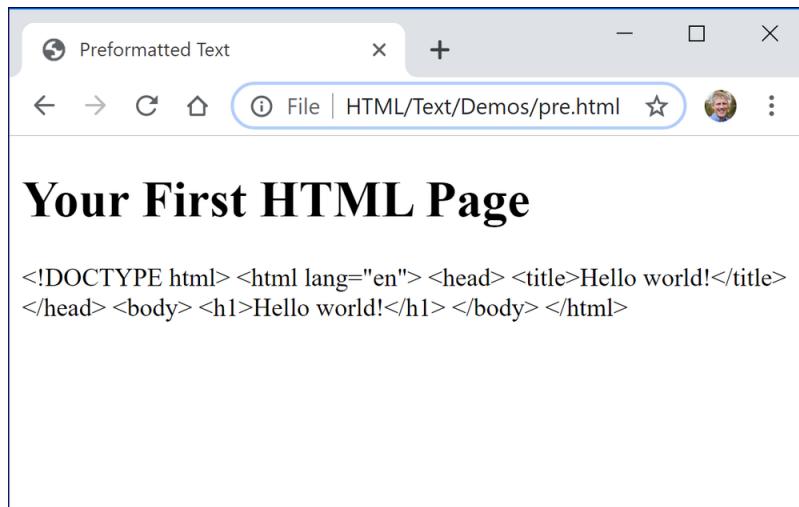
The page is rendered as follows:



The screenshot shows a browser window titled "Preformatted Text". The address bar indicates the file is located at "HTML/Text/Demos/pre.html". The main content area displays the following HTML code:

```
<!DOCTYPE html>
<html lang="en">
<head>
<title>Hello world!</title>
</head>
<body>
<h1>Hello world!</h1>
</body>
</html>
```

Notice that the whitespace within the `<pre>` tags is not condensed. Remove the `<pre>` tags and this page will appear like this:



The screenshot shows a browser window titled "Preformatted Text". The address bar indicates the file is located at "HTML/Text/Demos/pre.html". The main content area displays the same HTML code as above, but the output is rendered as plain text, showing the original whitespace and line breaks.

```
<!DOCTYPE html> <html lang="en"> <head> <title>Hello world!</title> </head> <body> <h1>Hello world!</h1> </body> </html>
```



3.7. Inline Semantic Elements

Semantic (*adj.*): Of or relating to meaning, especially meaning in language.¹⁰

Inline semantic elements provide meaningful information about the content they contain. The most common elements of this type are `em` and `strong`. Both elements indicate that the content should be

10. <https://www.ahdictionary.com/word/search.html?q=semantic>

emphasized. `` indicates stronger emphasis than ``. Most browsers bold `` content and italicize `` content. Inline semantic elements are listed below:¹¹

1. `<abbr>` – Used for abbreviations. Use the `title` attribute for the unabbreviated version. Default styling varies.
2. `` – Used to stylistically offset text without conveying any extra importance to it. Default styling is usually **bold**. Use sparingly, if at all.
3. `<cite>` – Used to cite a creative work. Default styling is usually *italic*.
4. `<code>` – Used to denote computer code. Default styling is usually `monospace`.
5. `<dfn>` – Used to indicate a term being defined. Default styling is usually *italic*.
6. `` – Used to add emphasis to text. Default styling is usually *italic*.
7. `<i>` – Used to convey an alternate voice or mood. Default styling is usually *italic*. Use sparingly, if at all.
8. `<kbd>` – Used to denote user input (e.g., from a keyboard or a voice input). Default styling is usually `monospace`.
9. `<mark>` – Used to mark text of special interest or importance. Default styling is usually highlighted in some way.
10. `<s>` – Used to mark text as no longer accurate or relevant. Default styling is to put a line through the text.¹²
11. `<samp>` – Used to denote output from a computer program. Default styling is usually `monospace`.
12. `<small>` – Used to represent text as a side comment or “small print.” Default styling is usually smaller than surrounding text.
13. `` – Used as a generic wrapper of inline content. The `` tag can be used for grouping elements, and meaning and style can be added through adding attributes (e.g., `id`, `class`, and `lang`).
14. `` – Used to add extra emphasis or importance to text. Default styling is usually **bold**.
15. `<sub>` – Used to denote a subscript.
16. `<sup>` – Used to denote a superscript.

11. For a complete list, see https://developer.mozilla.org/en-US/docs/Web/HTML/Element#inline_text_semantics.

12. There are special elements used to indicate editorial changes: `del` (for deleted text) and `ins` (for inserted text). The `del` and `ins` elements are usually used in draft documents or in documents that have an updated version.

17. `<time>` – Used to denote a date and/or time. It can include a `datetime` attribute with a machine-readable format of the enclosed date and/or time.
18. `<u>` – Indicates that text should have some form of non-textual annotation applied. By default, this is an underline, but if you use this element, you should probably change the default rendering to something different, so that it doesn't look like a link. Avoid using the `<u>` tag unless you have a specific semantic use case such as drawing attention to spelling or grammatical errors.

The following example shows how these inline elements are used.

Demo 3.7: Text/Demos/inline.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Meaningful Inline Elements</title>
7.  </head>
8.  <body>
9.  <h1>Meaningful Inline Elements</h1>
10. <p>
11.    The man yelled for his dog, <q><em>Come here, Snoopy!</em></q>
12.    When Snoopy didn't come, he yelled louder,
13.    <q><strong>Get over here now, Snoopy!</strong></q>
14.    He had named his dog <b>Snoopy</b> after the dog in
15.    <cite>Peanuts</cite>. After having called for him repeatedly,
16.    he finally remembered that Snoopy didn't speak English.
17.    He yelled, <q><dfn lang="es">Ven acá!</dfn></q>, which means
18.    <i>Come here!</i> in Spanish.
19. </p>
20. <p>
21.    Snoopy will be signing autographs on <time datetime="1984-03-05T17:00">March
      5, 1984 at 5:00pm</time>
22.    <s>Call 555-555-555 for tickets.</s> Tickets no longer available.
23. </p>
24. <p>
25.   <mark>
26.     Note that none of these tags should be used for formatting
27.     purposes. All formatting should be handled with
28.     <abbr title="Cascading Style Sheets">CSS</abbr>.
29.   </mark>
30. </p>
31. <p><small>This is just legalese. Don't read it.</small></p>
32. </body>
33. </html>
```

The page is rendered as follows:

The screenshot shows a web browser window with the title "Meaningful Inline Elements". The address bar indicates the file is located at "/Documents/Webucator/HTML/Text/Demos/inline.html". The main content area displays the following text:

Meaningful Inline Elements

The man yelled for his dog, “*Come here, Snoopy!*” When Snoopy didn't come, he yelled louder, “**Get over here now, Snoopy!**” He had named his dog **Snoopy** after the dog in *Peanuts*. After having called for him repeatedly, he finally remembered that Snoopy didn't speak English. He yelled, “*Ven acá!*”, which means *Come here!* in Spanish.

Snoopy will be signing autographs on March 5, 1984 at 5:00pm Call 555-555-555 for tickets. Tickets no longer available.

Note that none of these tags should be used for formatting purposes. All formatting should be handled with CSS.

This is just legalese. Don't read it.

All of these formatting effects can be created with CSS, so if you just want to change the formatting without implying any specific meaning, you should use CSS instead.

We recommend avoiding the `` and `<i>` tags. In most cases, `` and `` are more appropriate.

Exercise 3: Adding Inline Elements

 5 to 10 minutes

In this exercise, you will add inline elements to the Runners Home home page.

1. Open `index.html` from the `Text/Exercises` directory in Visual Studio Code.
2. Make the text “Hello, Stranger!” strongly emphasized.
3. Make the text “Disclosure: This is not a real website.” small.
4. Save your work and open your new page in a browser to test it.

Your finished page should look like this:

The screenshot shows a web browser window with the title bar "Runners Home". The address bar displays the URL "/Documents/Webucator/HTML/Text/Solutions/index-2.html". The main content area of the browser shows the "Runners Home" website. The page has a header with navigation links: Home | Resources | Calculator | Running Log | Running Terms | Links | Running Advice | Races | Register. Below the header, a greeting says "Hello, Stranger!". A welcome message reads "Welcome to Runners Home". A section titled "Advice" contains two subsections: "Best Running Tips" and "Best Health Tips". Each subsection has a brief description and a "Read more..." link. The "Best Running Tips" section also includes a "More advice articles..." link. A "Purpose" section describes the site's mission and lists its features: up-to-date race info and resources for runners. A disclosure note states that the site is not a real website. At the bottom, there is copyright information and contact links for email, Facebook, LinkedIn, and Twitter.

Runners Home

Home | Resources | Calculator | Running Log | Running Terms | Links | Running Advice | Races | Register

Hello, Stranger!

Welcome to Runners Home

Advice

Best Running Tips

There are good ways to train and bad ways to train. To get the most out of your runs... [Read more...](#)

Best Health Tips

In addition to keeping up with your physical training, you must be sure to take care of your general health... [Read more...](#)

More advice articles...

Purpose

Runners Home is dedicated to providing you with:

- the most up-to-date information on running races.
- the best resources for runners.

Disclosure: This is not a real website.

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info@runners-home.com | [Facebook](#) | [LinkedIn](#) | [Twitter](#)

You are welcome to play around with additional tags. In fact, we encourage you to do so.

Solution: Text/Solutions/index-2.html

```
-----Lines 1 through 8 Omitted-----  
9. <h1>Runners Home</h1>  
10. <div>  
11.   Home | Resources | Calculator | Running Log | Running Terms |  
12.   Links | Running Advice | Races | Register  
13. </div>  
14. <p><strong>Hello, Stranger!</strong></p>  
15. <p>Welcome to Runners Home</p>  
16. <h2>Advice</h2>  
17. <h3>Best Running Tips</h3>  
18. <p>There are good ways to train and bad ways to train. To get  
19.   the most out of your runs... Read more...</p>  
20. <h3>Best Health Tips</h3>  
21. <p>In addition to keeping up with your physical training, you  
22.   must be sure to take care of your general health...  
23.   Read more...</p>  
24. <p>More advice articles...</p>  
25. <h2>Purpose</h2>  
26. <p>Runners Home is dedicated to providing you with:<br>  
27.   &#8226; the most up-to-date information on running races.<br>  
28.   &#8226; the best resources for runners.  
29. </p>  
30. <p><small>Disclosure: This is not a real website.</small></p>  
31. <hr>  
32. <p>&copy; 2022 Runners Home. All rights reserved.</p>  
33. <div>  
34.   info@runners-home.com |  
35.   Facebook |  
36.   LinkedIn |  
37.   Twitter  
38. </div>  
-----Lines 39 through 40 Omitted-----
```

Evaluation Copy!

Conclusion

In this lesson, you have learned to work with paragraphs, headings, and other text elements. You can now create a basic HTML page.

LESSON 4

HTML Links

Topics Covered

- Basic text links.
- Absolute and relative paths.
- Links that open in new tabs or windows.
- Email links.
- Links to specific locations on a page.

Introduction

The ability to link from one page to another is what makes HTML hyper. Calling it **Hypertext**, however, is a bit of a misnomer, as images can also be linked.



4.1. Text Links

The tag for a link is perhaps the least intuitive of all the HTML tags. It is `<a>`, and it comes from the word “anchor,” as `<a>` tags used to be used to create locations to link to, known as *anchors*, as well as the links themselves. By itself, the `<a>` tag does nothing. To create a link, it requires the `href` attribute, which takes as a value the path to the file or location to which to link. The syntax is as follows:

```
<a href="path_to_file">Link Text</a>
```

A couple of examples:

```
<a href="bios/john-lennon.html">John Lennon</a>
<a href="https://www.webucator.com">Webucator</a>
```

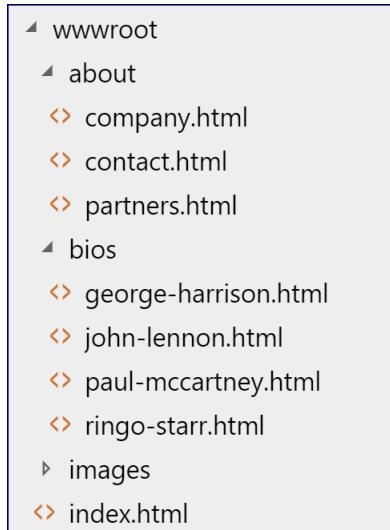


4.2. Absolute vs. Relative Paths

Paths are absolute or relative:

- Absolute paths always start from the top-level directory (the *web root*) and work their way downward toward the referenced file.
- Relative paths start from the current location (the location of the file containing the path) and work their way to the referenced file from that location.

For the examples in this section, we will use the following directory tree:



Things to notice:

1. The `index.html` file on the bottom is a direct child of the `wwwroot` folder.
2. The `about`, `bios`, and `images` folders are also children of the `wwwroot` folder. They each contain their own files.

Assume that this site is located at `https://www.example.com` and that the `wwwroot` folder is the web root, meaning that it is the top-level directory. This means that when a user visits `https://www.ex`

ample.com/index.html, the index.html page within the wwwroot folder will be downloaded to the browser.

❖ 4.2.1. Absolute Paths

An absolute path shows the complete path to a file starting from the web root.

The absolute path to the web root from a page on the same domain is simply a forward slash (/). So, given the folder structure shown above, a link on company.html to index.html could be written like this:

```
<a href="/index.html">Home Page</a>
```

The same link could be placed on any page in any folder below the wwwroot folder or on any page in the wwwroot folder itself.

Using an absolute path, a link to company.html would include the about directory, like this:

```
<a href="/about/company.html">About Our Company</a>
```

External Links

When linking to a file at a different domain, you must identify the location of the domain using the domain name (or IP address) of the site. Again, assume that the directory structure shown above is found at https://www.example.com. A link to company.html from another site would be written like this:

```
<a href="https://www.example.com/about/company.html">About the Beatles</a>
```

❖ 4.2.2. Relative Paths

Relative paths can only be used to link to other files under the same web root. A relative path indicates where a file is *relative to* the file that contains the link. The folder (or directory) that contains the file being worked on is called the *current directory*. The relative path to another file that is also in the current directory is just the name of that file. For example, since company.html and contact.html are found in the same directory, they can link to each other simply by specifying the file name. The following shows a link that could be used in contact.html to company.html:

```
<a href="company.html">About Our Company</a>
```

The relative path to a file in a subdirectory of the current directory must include the name of the subdirectory. For example, to link to `company.html` from `index.html` you must first point to the `about` directory, like so:

```
<a href="about/company.html">About Our Company</a>
```

The relative path to a file in a directory above the current directory should begin with “`.. /`”. For example, the following shows a link to `index.html` from `company.html`:

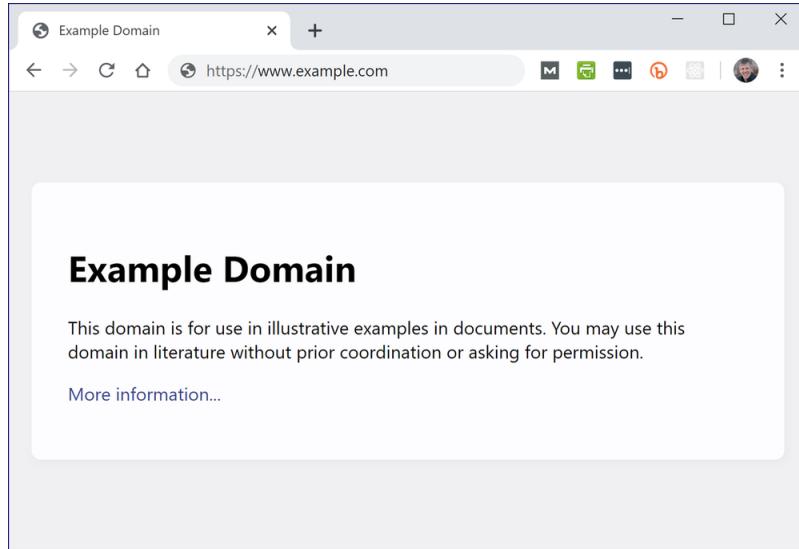
```
<a href="../index.html">Home Page</a>
```

❖ 4.2.3. Default Pages

The web server administrator can set up default page names to look for when a path ends with a directory name without specifying a file. Often these files are called `index.html`. In this case, the following URLs would be identical, all loading `index.html`:

- `https://www.example.com`
- `https://www.example.com/`
- `https://www.example.com/index.html`

You can give this a try by visiting those pages at `example.com`, which is an actual website used for demonstrating just this sort of thing:



*

4.3. Targeting New Tabs

The `target` attribute is used to specify the browser tab (or window) in which the linked page will open. For example:

```
<a href="company.html" target="newtab">Our Company</a>
```

If there is no open browser tab with the specified `target` name, a new tab will be opened with that name. As long as that tab stays open, future links with the same `target` value will target that tab.

Note that “`newtab`” has no special meaning. We could name it “`external`,” “`newwin`,” “`roxanne`,” or anything else we want.

Try it out by doing the following:

1. Open `Links/Demos/links.html` in Visual Studio Code and review the first two links below the **Targeting New Tabs** heading:

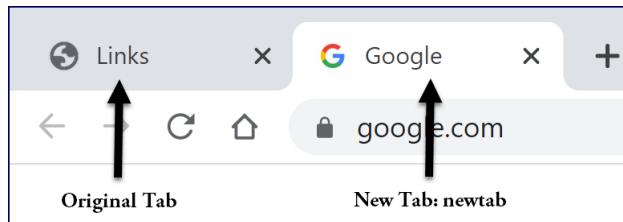
```
<a href="https://www.google.com" target="newtab">Google</a>
<a href="https://www.nytimes.com" target="newtab">NY Times</a>
```

2. Open `Links/Demos/links.html` in your browser.

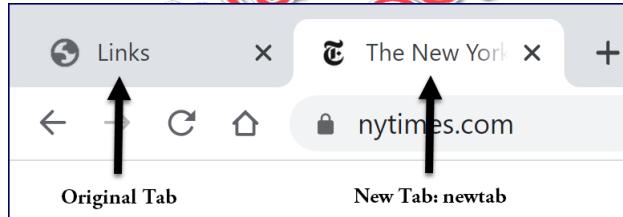
3. Under **Targeting New Tabs**, click the **Google** link:



This link has a target of newtab. The page will open in a new tab:



4. Without closing the tab with Google in it, go back to the tab that has `links.html` open.
5. Under **Targeting New Tabs**, click the **NY Times** link. This link also has a target of newtab. The page will open in the same tab in which Google opened:



Other links targeting newtab would also open in that same tab.

❖ 4.3.1. `_blank` Target

To force each link to target a brand new tab or window, use `_blank` as the value of the `target` attribute as shown here:

```
<a href="company.html" target="_blank">Our Company</a>
```

Try it out by doing the following:

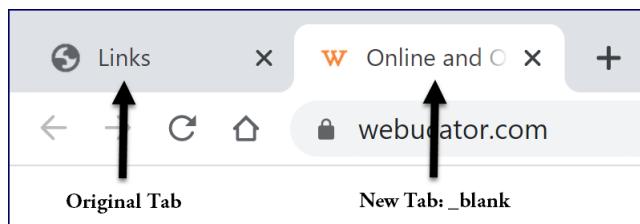
1. Open `Links/Demos/links.html` in Visual Studio Code and review the third link below the **Targeting New Tabs** heading:

```
<a href="https://www.webucator.com" target="_blank">Webucator</a>
```

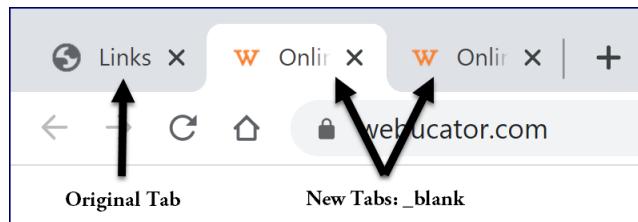
2. Open `Links/Demos/links.html` in your browser if it's not already open.
3. Under **Targeting New Tabs**, click the **Webucator** link:



This link has a target of `_blank`. The page will open in a new tab:



4. Without closing the tab with Webucator in it, go back to the tab that has `links.html` open.
5. Under **Targeting New Tabs**, click the **Webucator** link again. Rather than reusing the same tab, it will open the page in another brand new tab:



As a rule of thumb, if you're going to have links open in new tabs, we would use a named `target` rather than the generic `_blank`, so that the user doesn't get inundated with new tabs.

As an even more important rule of thumb, we would avoid targeting new tabs/windows altogether. Some websites do this so that the linked page will not replace their web page, but it is bad design. Generally, you do not want to surprise your users, who are accustomed to clicking the **Back** button to

get back to a page they were just on. When a link opens in a new tab or window, users cannot click the **Back** button to get back to your page. Instead, they have to know to go back to the tab that your page is on, making it even more difficult to get back to your page. An exception would be when you are quite certain that the user wants to stay on your page because they are following a setup guide or a tutorial. In this case, it can be helpful to target new tabs, so that the user can easily toggle back and forth between the instructions they are following and the linked pages.



4.4. Email Links

Email links are used to open an email client to start a new email message. The syntax is similar to the links we have seen thus far. However, for email links, the value of the `href` attribute must begin with `mailto:` and ends with an email address. For example:

```
<a href="mailto:paul@example.com">Email Paul</a>
```

It is good practice to include the email address as the text of the link, so that people who are printing the page or whose setup does not support email links can see the actual email address. For example:

```
Email Paul at <a href="mailto:paul@example.com">paul@example.com</a>.
```



Exercise 4: Adding Links

⌚ 40 to 60 minutes

In this exercise, you will add links to the pages of the Runners Home website. The home page ([Links/Exercises/index.html](#)) looks like this:

The links above the footer should go to the following pages:



The footer links should go to:

15. info@runners-home.com. This should be an email link.
16. <https://www.facebook.com/webucator>
17. <https://www.linkedin.com/companies/webucator>
18. <https://twitter.com/webucator>

After you have finished adding links to the home page, open each of the other pages in the **Links/Exercises** folder and add the same header and footer links that you added in `index.html`. Copy and paste is your friend, but be careful: relative links on pages in subfolders will be different from links in the root folder and from links in other subfolders.

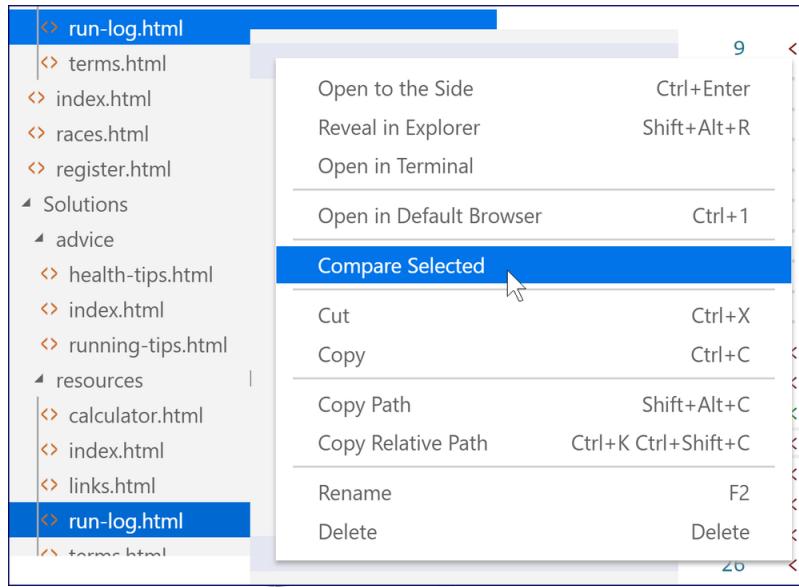
In addition to the header and footer links, add the following links:

1. [races.html](#)
 - A. “AJC Peachtree Road Race”: <https://www.atlantatrackclub.org/peachtree>
 - B. “Boilermaker”: <https://www.boilermaker.com>
 - C. “NYC Marathon”: <https://www.nyrr.org/>
2. [advice/index.html](#)
 - A. “Running Tips”: the **Running Tips** page.
 - B. “Health Tips”: the **Health Tips** page.

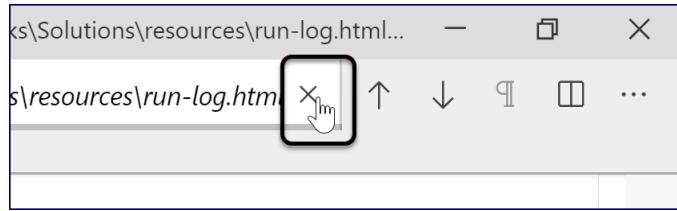
3. `advice/health-tips.html` and `advice/running-tips.html`
 - A. “More Advice Articles”: **Running Advice** index page.
4. `resources/index.html`
 - A. “Calculator”: the **Calculator** page.
 - B. “Running Log”: the **Running Log** page.
 - C. “Running Terms”: the **Running Terms** page.
 - D. “Links”: the **Links** page.
5. `resources/links.html`
 - A. “Map My Run”: <https://www.mapmyrun.com>
 - B. “Runners World”: <https://www.runnersworld.com>
 - C. “Strength Running”  <https://strengthrunning.com>
 - D. “More Resources”: **Resources** index page.
6. `resources/calculator.html`, `resources/run-log.html`, and `resources/terms.html`
 - A. “More Resources”: **Resources** index page.

You may find Visual Studio Code’s **Compare Selected** tool useful for comparing the solutions you did in the **Exercises** folder with the ones we included in the **Solutions** folder.

1. In Visual Studio Code’s **Explorer** panel, hold down the **Ctrl** key and click the two files you wish to compare. They should become highlighted.
2. Right-click one of the files and select **Compare Selected**:



3. You will get a side-by-side view of the files with differences highlighted.
4. Close the files when you are done comparing them:



Solution: Links/Solutions/index.html

-----Lines 1 through 9 Omitted-----

```
10. <div>
11.   <a href="index.html">Home</a> |
12.   <a href="resources/index.html">Resources</a> |
13.   <a href="resources/calculator.html">Calculator</a> |
14.   <a href="resources/run-log.html">Running Log</a> |
15.   <a href="resources/terms.html">Running Terms</a> |
16.   <a href="resources/links.html">Links</a> |
17.   <a href="advice/index.html">Running Advice</a> |
18.   <a href="races.html">Races</a> |
19.   <a href="register.html">Register</a>
20. </div>
21. <p><strong>Hello, Stranger!</strong></p>
22. <p>Welcome to Runners Home</p>
23. <h2>Advice</h2>
24. <h3>Best Running Tips</h3>
25. <p>There are good ways to train and bad ways to train. To get
26.     the most out of your runs...
27.     <a href="advice/running-tips.html">Read more...</a>
28. </p>
29. <h3>Best Health Tips</h3>
30. <p>In addition to keeping up with your physical training, you
31.     must be sure to take care of your general health...
32.     <a href="advice/health-tips.html">Read more...</a>
33. </p>
34. <p><a href="advice/index.html">More advice articles...</a></p>
35. <h2>Purpose</h2>
36. <p>Runners Home is dedicated to providing you with:<br>
37.     &#8226; <a href="races.html">the most up-to-date
38.         information on running races</a>. <br>
39.     &#8226; <a href="resources/index.html">the best
40.         resources for runners</a>.
41. </p>
42. <p><small>Disclosure: This is not a real website.</small></p>
43. <hr>
44. <p>&copy; 2022 Runners Home. All rights reserved.</p>
45. <div>
46.   <a href="mailto:info@runners-home.com">info@runners-home.com</a> |
47.   <a href="https://www.facebook.com/webucator">Facebook</a> |
48.   <a href="https://www.linkedin.com/companies/webucator">LinkedIn</a> |
49.   <a href="https://twitter.com/webucator">Twitter</a>
50. </div>
```

-----Lines 51 through 52 Omitted-----

Solution: Links/Solutions/races.html

```
-----Lines 1 through 20 Omitted-----  
21. <h2>Races</h2>  
22. <div>  
23.   March 15th,  
24.   <a href="https://www.atlantatrackclub.org/peachtree">  
25.     AJC Peachtree Road Race  
26.   </a>,  
27.   10K, Atlanta, GA<br>  
28.   July 11th,  
29.   <a href="https://www.boilermaker.com">Boilermaker</a>,  
30.   15K, Utica, NY<br>  
31.   November 3rd, <a href="https://www.nyrr.org/">NYC Marathon</a>,  
32.   26.22 mi, New York, NY  
33. </div>
```

-----Lines 34 through 44 Omitted-----

The links in the header and footer of `races.html` are the same as they are in `index.html`.

The solution to `register.html` is not shown as it only has links in the header and footer, which are also the same as they are in `index.html`.

Solution: Links/Solutions/advice/index.html

```
-----Lines 1 through 9 Omitted-----  
10. <div>  
11.   <a href="../index.html">Home</a> |  
12.   <a href="../resources/index.html">Resources</a> |  
13.   <a href="../resources/calculator.html">Calculator</a> |  
14.   <a href="../resources/run-log.html">Running Log</a> |  
15.   <a href="../resources/terms.html">Running Terms</a> |  
16.   <a href="../resources/links.html">Links</a> |  
17.   <a href="index.html">Running Advice</a> |  
18.   <a href="../races.html">Races</a> |  
19.   <a href="../register.html">Register</a>  
20. </div>  
21. <h2>Running Advice</h2>  
22. <div>  
23.   <a href="running-tips.html">Running Tips</a><br>  
24.   <a href="health-tips.html">Health Tips</a>  
25. </div>  
26. <p><small>Disclosure: This is not a real website.</small></p>  
27. <hr>  
28. <p>&copy; 2022 Runners Home. All rights reserved.</p>  
29. <div>  
30.   <a href="mailto:info@runners-home.com">info@runners-home.com</a> |  
31.   <a href="https://www.facebook.com/webucator">Facebook</a> |  
32.   <a href="https://www.linkedin.com/companies/webucator">LinkedIn</a> |  
33.   <a href="https://twitter.com/webucator">Twitter</a>  
34. </div>  
-----Lines 35 through 36 Omitted-----
```

Solution: Links/Solutions/advice/health-tips.html

```
-----Lines 1 through 20 Omitted-----  
21. <h2>Health Tips</h2>  
22. <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
23.   Aliquam et gravida sapien, facilisis condimentum arcu.  
24.   Morbi eget dui iaculis, porttitor eros et, tincidunt erat...</p>  
25. <p><a href="index.html">More Advice Articles</a></p>  
26. <p><small>Disclosure: This is not a real website.</small></p>  
-----Lines 27 through 36 Omitted-----
```

The links in advice/running-tips.html are the same as in health-tips.html.

Solution: Links/Solutions/resources/index.html

-----Lines 1 through 9 Omitted-----

```
10. <div>
11.   <a href="../index.html">Home</a> |
12.   <a href="index.html">Resources</a> |
13.   <a href="calculator.html">Calculator</a> |
14.   <a href="run-log.html">Running Log</a> |
15.   <a href="terms.html">Running Terms</a> |
16.   <a href="links.html">Links</a> |
17.   <a href="../advice/index.html">Running Advice</a> |
18.   <a href="../races.html">Races</a> |
19.   <a href="../register.html">Register</a>
20. </div>
21. <h2>Resources</h2>
22. <div>
23.   - <a href="calculator.html">Calculator</a><br>
24.   - <a href="run-log.html">Running Log</a><br>
25.   - <a href="terms.html">Running Terms</a><br>
26.   - <a href="links.html">Links</a>
27. </div>
28. <p><small>Disclosure: This is not a real website.</small></p>
29. <hr>
30. <p>&copy; 2022 Runners Home. All rights reserved.</p>
31. <div>
32.   <a href="mailto:info@runners-home.com">info@runners-home.com</a> |
33.   <a href="https://www.facebook.com/webucator">Facebook</a> |
34.   <a href="https://www.linkedin.com/companies/webucator">LinkedIn</a> |
35.   <a href="https://twitter.com/webucator">Twitter</a>
36. </div>
```

-----Lines 37 through 38 Omitted-----

Solution: Links/Solutions/resources/links.html

```
-----Lines 1 through 9 Omitted-----  
10. <div>  
11.   <a href="../index.html">Home</a> |  
12.   <a href="index.html">Resources</a> |  
13.   <a href="calculator.html">Calculator</a> |  
14.   <a href="run-log.html">Running Log</a> |  
15.   <a href="terms.html">Running Terms</a> |  
16.   <a href="links.html">Links</a> |  
17.   <a href="../advice/index.html">Running Advice</a> |  
18.   <a href="../races.html">Races</a> |  
19.   <a href="../register.html">Register</a>  
20. </div>  
21. <h2>Useful Links</h2>  
22. <div>  
23.   - <a href="https://www.mapmyrun.com">Map My Run</a><br>  
24.   - <a href="https://www.runnersworld.com">Runners World</a><br>  
25.   - <a href="https://strengthrunning.com">Strength Running</a>  
26. </div>  
27. <p><a href="index.html">More Resources</a></p>  
28. <p><small>Disclosure: This is not a real website.</small></p>  
29. <hr>  
30. <p>© 2022 Runners Home. All rights reserved.</p>  
31. <div>  
32.   <a href="mailto:info@runners-home.com">info@runners-home.com</a> |  
33.   <a href="https://www.facebook.com/webucator">Facebook</a> |  
34.   <a href="https://www.linkedin.com/companies/webucator">LinkedIn</a> |  
35.   <a href="https://twitter.com/webucator">Twitter</a>  
36. </div>  
-----Lines 37 through 38 Omitted-----
```

The links in the header and footer of resources/links.html are the same as they are in resources/index.html.

The header, footer, and “More Resources” links in resources/calculator.html, resources/run-log.html, and resources/terms.html are the same as in resources/links.html.



4.5. Lorem Ipsum

You may have noticed that some of the pages on our site use the following text:

`Lorem ipsum dolor sit amet, consectetur adipiscing elit.
 Aliquam et gravida sapien, facilisis condimentum arcu.
 Morbi eget dui iaculis, porttitor eros et, tincidunt erat...`

This *lorem ipsum* text is commonly used as dummy placeholder text. You can copy it from <https://www.lipsum.com>.



4.6. The title Attribute

The `title` attribute can be used to provide a description about a link. The description is displayed by the browser as a tooltip. Screen readers might read the description to a blind user.

Here's an example:

```
<a href="https://www.webucator.com" title="Webucator Home Page">Webucator</a>
```

When you hover over this link, the `title` appears as a tip:



This is especially useful when using an image as a link as it might not be clear from the image itself where the link points. The `title` attribute can be used to make the link destination clear. You will learn how to do this in the next lesson.



4.7. Targeting a Specific Location on the Page

Every HTML element can take an `id` attribute, which uniquely identifies that element on the page. The value of the `id` attribute must not contain any whitespace.

To target a specific element on the page, the link's `href` value should point to that element's `id` attribute prefaced with a number sign.

For example, assume you have an `<h2>` tag with the `id` of "john":

```
<h2 id="john">John Lennon</h2>
```

To target that location, use:

```
<a href="#john">Read about John</a>
```

You can also link to locations on other pages:

```
<a href="about.html#john">Read about John</a>
```

Or:

```
<a href="https://www.example.com/about.html#john">Read about John</a>
```

The following file shows more examples:

Demo 4.1: Links/Demos/location-links.html

-----Lines 1 through 8 Omitted-----

```
9. <h1>Targeting Locations on a Page</h1>
10. <h2>Links to Locations on Remote Pages</h2>
11. <div>
12.   <a href="https://www.runners-home.com/resources/terms.html#dnf">DNF</a>
13. </div>
14. <h2>Links to Locations on This Page</h2>
15. <div>
16.   <a href="#alice"
17.     title="A MAD TEA-PARTY - Lewis Carroll">A Mad Tea-Party</a><br>
18.   <a href="#cinderella"
19.     title="CINDERELLA - the brothers Grimm">Cinderella</a><br>
20.   <a href="#naughtyboy"
21.     title="THE NAUGHTY BOY - H.C. Andersen">The Naughty Boy</a>
22. </div>
23. <hr>
24. <h2>Locations on This Page</h2>
25. <p>Each title below has an id attribute.</p>
26. <h3 id="alice">A MAD TEA-PARTY - Lewis Carroll</h3>
27. <p>There was a table set out under a tree in front of the house, and
-----Lines 28 through 31 Omitted-----
32.   asleep, I suppose it doesn't mind."
33.   <a href="https://www.gutenberg.org/files/11/11-h/11-h.htm#link2HCH0007">
34.     Continue reading</a></p>
35. <hr>
36. <h3 id="cinderella">CINDERELLA - the brothers Grimm</h3>
37. <p>The wife of a rich man fell sick: and when she felt that her end
-----Lines 38 through 48 Omitted-----
49.   on, and laughed at her and turned her into the kitchen.
50.   <a href="https://www.gutenberg.org/files/11027/11027-h/11027-h.htm#cinderella">
51.     Continue reading</a></p>
52. <hr>
53. <h3 id="naughtyboy">THE NAUGHTY BOY - Hans Christian Andersen</h3>
54. <p>Along time ago, there lived an old poet, a thoroughly kind old
-----Lines 55 through 57 Omitted-----
58.   blazed and the roasting apple hissed.
59.   <a href="https://www.gutenberg.org/files/1597/1597-h/1597-h.htm#link2H_4_0017">
60.     Continue reading</a></p>
61. <hr>
62. <div><a href="#top">Back to top</a></div>
63. </body>
64. </html>
```

The “top” Keyword

You will notice in the demo that the last link is to “#top”, but there is no element on the page with the id “top”. That is because “top” is a keyword. Browsers know that “top” references the top of the page.

Conclusion

In this lesson, you have learned to create text links, to work with absolute and relative paths, to target new tabs, to create email links, and to create and link to specific locations on a page.

Evaluation
Copy

LESSON 5

HTML Images

Topics Covered

- Adding images to a website.
- Creating image links.
- Making images accessible.
- Providing image fallbacks.

Introduction

Modern browsers support several types of images, including:

- Graphics Interchange Format (GIF)
- Joint Photographic Expert Group image (JPEG)
- Portable Network Graphics (PNG)
- Scalable Vector Graphics (SVG)
- Web Picture format (WebP)

WebP is generally the best choice for both image quality and compression and is supported by Chrome, Edge, Firefox, Opera, and Safari, but not by Internet Explorer.



5.1. Inserting Images

The `` tag is used to include an image in an HTML page. The `` tag is an empty tag, meaning it has no closing tag. Its `src` attribute is used to reference an image file using a relative or absolute path. Here is the syntax:

```

```

The following demo shows how to use the tag:

Demo 5.1: Images/Demos/images.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Images</title>
7.  </head>
8.  <body>
9.  <h1>Images</h1>
10. <p></p>
11. <hr>
12. <p></p>
13. <hr>
14. <p></p>
15. </body>
16. </html>
```

The page will render as follows:¹³

13. The https://commons.wikimedia.org/wiki/File:R._John_Wright_Winnie_the_Pooh_Bear.jpg image is used under the terms of GNU Free Documentation License, version 1.2 (https://commons.wikimedia.org/wiki/Commons:GNU_Free_Documentation_License,_version_1.2).



❖ 5.1.1. Making Images Accessible

Alternative Text

To add alternative text for an image, use the `alt` attribute as shown below:

```

```

Alternative text is displayed...

1. When the user's browser does not support images.
2. As the image is downloading.
3. When the user hovers over the image with the mouse (in some browsers).

Most importantly, alternative text is used by screen readers to describe an image for the visually impaired.

Providing Longer Descriptions

If an image depicts something complicated, such as a graph or chart, a longer description of the image can be provided using the `aria-describedby` attribute.¹⁴

❖ 5.1.2. height and width Attributes

The `img` element also takes `height` and `width` attributes that set the dimensions (in pixels) to use to display the image on the page. It is not good practice to “resize” the image using these attributes. If you use these attributes, you should set the values to the actual height and width of the image. Using the `height` and `width` attributes lets the browser know how much space to allocate for the image without having to wait for the image itself to download. Use of these attributes may promote faster rendering of the web page:

```

```



5.2. Image Links

To create an image link, wrap an `<a>` tag around your image, like so:

^{14.} See https://developer.mozilla.org/en-US/docs/Web/Accessibility/ARIA/ARIA_Techniques/Using_the_aria-describedby_attribute for information on the `aria-describedby` attribute.

```
<a href="index.html" title="Link to Home Page">  
    
</a>
```

The following demo shows some image links:

Demo 5.2: Images/Demos/image-links.html

```
-----Lines 1 through 8 Omitted-----  
9.  <h1>Image Links</h1>  
10. <a href="https://www.google.com" title="Visit Google">  
11.     
12. </a>  
13. <hr>  
14. <a href="https://en.wikipedia.org/wiki/Hundred_Acre_Wood"  
15.   title="Visit site about Winnie the Pooh">  
16.     
17. </a>  
18. <hr>  
19. <a href="../Solutions/index.html" title="Link to Home Page">  
20.     
21. </a>  
-----Lines 22 through 23 Omitted-----
```

Including the `title` attribute results in a tooltip in many browsers:



Exercise 5: Adding Images to the Page

⌚ 15 to 25 minutes

In this exercise, you will add images to `index.html`. Here is the resulting page:

The screenshot shows a web browser window titled "Runners Home". The address bar displays the URL "nn/Documents/Webucator/HTML/Images/Solutions/index.html". The page content includes a red logo with a white runner icon, the title "Runners Home", a navigation menu with links like Home, Resources, Calculator, Running Log, etc., a greeting "Hello, Stranger!", a welcome message, a section titled "Advice" with "Best Running Tips" and an illustration of two runners, a section titled "Best Health Tips" with an illustration of various vegetables, and a "Purpose" section listing the website's dedication to providing up-to-date running information and resources. At the bottom, there is a disclosure note about it not being a real website, copyright information, and social media links.

Runners Home

[Home](#) | [Resources](#) | [Calculator](#) | [Running Log](#) | [Running Terms](#) | [Links](#) | [Running Advice](#) | [Races](#) | [Register](#)

Hello, Stranger!

Welcome to Runners Home

Advice

Best Running Tips

There are good ways to train and bad ways to train. To get the most out of your runs... [Read more...](#)

Best Health Tips

In addition to keeping up with your physical training, you must be sure to take care of your general health... [Read more...](#)

[More advice articles...](#)

Purpose

Runners Home is dedicated to providing you with:

- [the most up-to-date information on running races](#).
- [the best resources for runners](#).

Disclosure: This is not a real website.

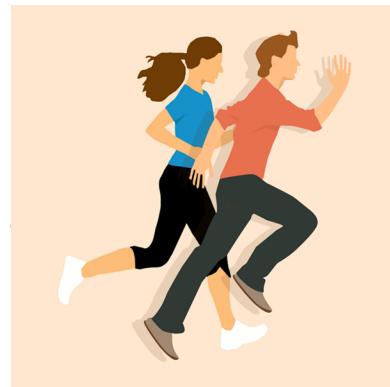
© 2022 Runners Home. All rights reserved.

info@runners-home.com

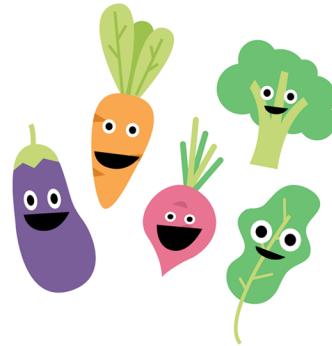
1. Open Images/Exercises/index.html for editing.
2. Add the following images, all of which are in the Images/Exercises/images directory. Be sure to include alternative text.
 - A. runners-home.png should link to index.html.



- B. tips-running.png¹⁵ should link to advice/running-tips.html.



- C. tips-health.png¹⁶ should link to advice/health-tips.html.



15. The <https://pixabay.com/illustrations/running-woman-man-together-family-2897357> image is used under the terms of Pixabay License (<https://pixabay.com/service/license/>).

16. The <https://pixabay.com/illustrations/veggies-vegetables-healthy-food-2340299> image is used under the terms of Pixabay License (<https://pixabay.com/service/license/>).

- D. `facebook-icon.png`, `linkedin-icon.png`, and `twitter-icon.png`¹⁷ should replace the text used in the footer of the exercise file.



17. The <https://pixabay.com/de/illustrations/icon-social-media-linkedin-facebook-2083456> image is used under the terms of Pixabay License (<https://pixabay.com/service/license/>).

Solution: Images/Solutions/index.html

```
-----Lines 1 through 8 Omitted-----
9.  <a href="index.html">
10.    
11.  </a>
-----Lines 12 through 26 Omitted-----
27.  <h3>Best Running Tips</h3>
28.  <a href="advice/running-tips.html">
29.    
30.  </a>
31.  <p>There are good ways to train and bad ways to train. To get
32.    the most out of your runs...
33.    <a href="advice/running-tips.html">Read more...</a>
34.  </p>
35.  <h3>Best Health Tips</h3>
36.  <a href="advice/health-tips.html">
37.    
38.  </a>
-----Lines 39 through 53 Omitted-----
54.  <div>
55.    <a href="mailto:info@runners-home.com">info@runners-home.com</a>
56.    <a href="https://www.facebook.com/webucator">
57.      </a>
58.    <a href="https://www.linkedin.com/companies/webucator">
59.      </a>
60.    <a href="https://twitter.com/webucator">
61.      </a>
62.  </div>
-----Lines 63 through 64 Omitted-----
```



5.3. Providing Alternative Images

All modern browsers support the newer *WebP* image type, which provides better quality and compression than PNG, JPEG, and GIF images. Internet Explorer, however, does not. That may not be an issue as Internet Explorer has a very small share of the market. However, if you do need to support Internet Explorer, that doesn't mean you cannot use WebP images. To do so, you will need to use the `picture` element, like so:

```
<picture>
  <source srcset="images/logo.webp" type="image/webp">
  
</picture>
```

Notice that the `picture` element has a child `source` element with a `srcset` attribute that points to the image file and a `type` attribute that indicates what type of image it is. If the browser supports that type of image, it will use that file. If not, it will fall back on the image file in the subsequent `img` element.

More on WebP

For more information on WebP and a free tool for converting PNG and JPG files to WebP, see <https://developers.google.com/speed/webp>.

Conclusion

In this lesson, you have learned to add images to a web page, to make those images accessible, to create image links, and to use the `picture` element to provide image fallbacks.

LESSON 6

HTML Lists

Topics Covered

Unordered lists.

Ordered lists.

Definition lists.

Introduction

There are three types of lists in HTML: unordered, ordered, and definition lists. In this lesson, you will learn how to create all three.

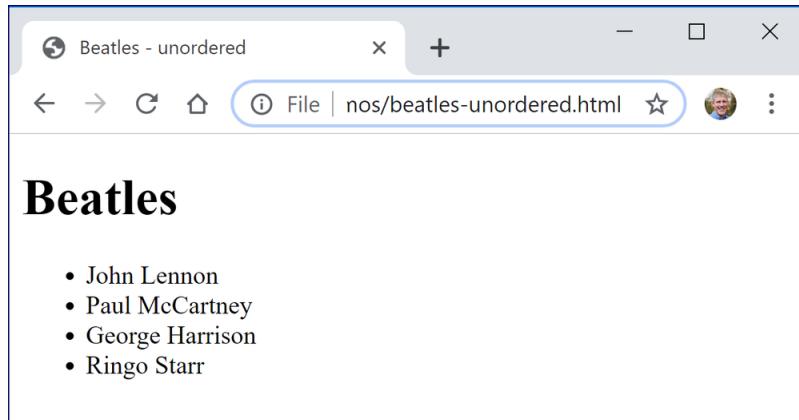
6.1. Unordered Lists

Unordered lists are rendered as bulleted lists. Take a look at the following code sample:

Demo 6.1: Lists/Demos/beatles-unordered.html

```
-----Lines 1 through 8 Omitted-----  
9.      <h1>Beatles</h1>  
10.     <ul>  
11.       <li>John Lennon</li>  
12.       <li>Paul McCartney</li>  
13.       <li>George Harrison</li>  
14.       <li>Ringo Starr</li>  
15.     </ul>  
-----Lines 16 through 17 Omitted-----
```

The `` tag starts an unordered list. Each list item is contained in `` tags. The following screenshot shows how this code would be rendered:



❖ 6.1.1. Nesting Unordered Lists

Unordered lists can also be nested. The browsers use indentation and different styles of bullets¹⁸ to display the nested lists. The following example shows how this works:

18. Both the indentation and the style of bullet can be controlled with CSS.

Demo 6.2: Lists/Demos/beatles-unordered-nested.html

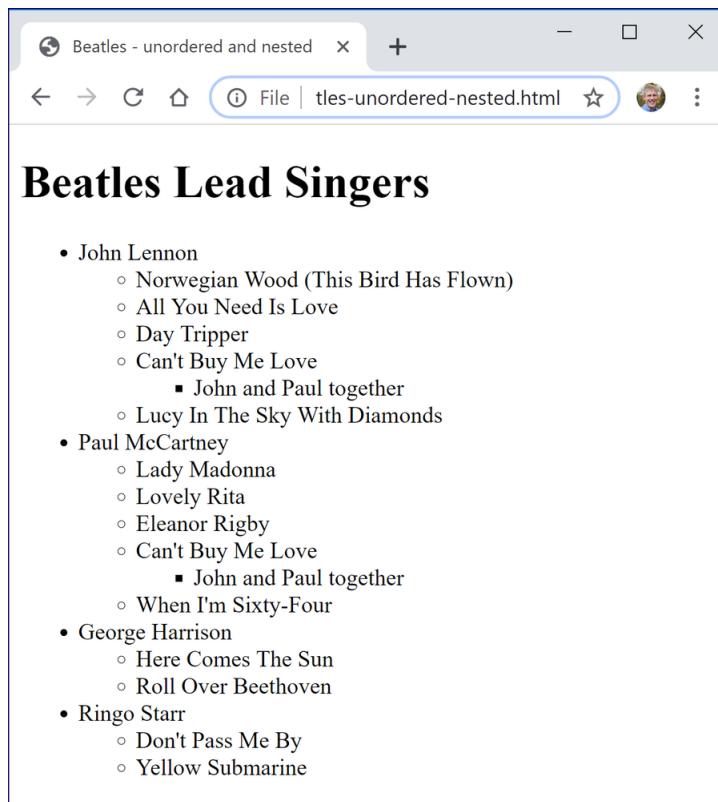
-----Lines 1 through 8 Omitted-----

```
9.      <h1>Beatles Lead Singers</h1>
10.     <ul>
11.       <li>John Lennon
12.         <ul>
13.           <li>Norwegian Wood (This Bird Has Flown)</li>
14.           <li>All You Need Is Love</li>
15.           <li>Day Tripper</li>
16.           <li>Can't Buy Me Love
17.             <ul>
18.               <li>John and Paul together</li>
19.             </ul>
20.           </li>
21.           <li>Lucy In The Sky With Diamonds</li>
22.         </ul>
23.       </li>
24.       <li>Paul McCartney
25.         <ul>
26.           <li>Lady Madonna</li>
27.           <li>Lovely Rita</li>
28.           <li>Eleanor Rigby</li>
29.           <li>Can't Buy Me Love
30.             <ul>
31.               <li>John and Paul together</li>
32.             </ul>
33.           </li>
34.           <li>When I'm Sixty-Four</li>
35.         </ul>
36.       </li>
37.       <li>George Harrison
38.         <ul>
39.           <li>Here Comes The Sun</li>
40.           <li>Roll Over Beethoven</li>
41.         </ul>
42.       </li>
43.       <li>Ringo Starr
44.         <ul>
45.           <li>Don't Pass Me By</li>
46.           <li>Yellow Submarine</li>
47.         </ul>
48.       </li>
49.     </ul>
```

-----Lines 50 through 51 Omitted-----

Notice that the nested unordered lists are siblings to plain text. For example, the text “George Harrison” and the unordered list that follows that text both are contained within the same parent `` tag. Only list items, not lists themselves, can contain nested (i.e., child) lists. In other words, lists contain list items, which can contain lists, which contain list items, which can contain lists, which contain list items, and so on and so forth, ad infinitum.

Here is the resulting page:



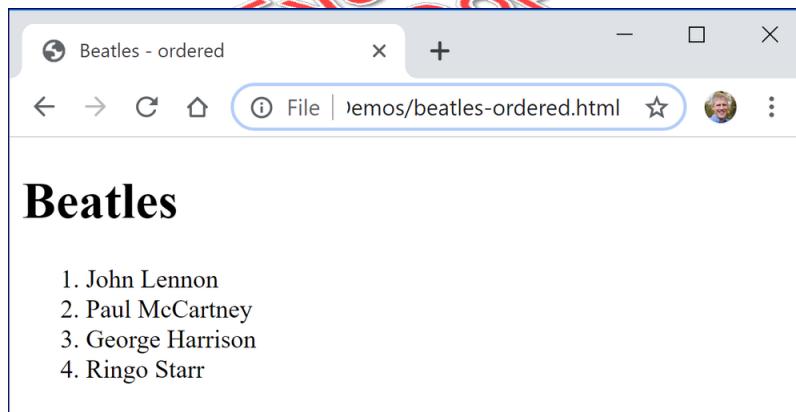
6.2. Ordered Lists

Ordered lists are similar to unordered lists. They are created with the `` tag and, by default, will display list items with numbers. Take a look at the following code:

Demo 6.3: Lists/Demos/beatles-ordered.html

```
-----Lines 1 through 8 Omitted-----  
9.    <h1>Beatles</h1>  
10.   <ol>  
11.     <li>John Lennon</li>  
12.     <li>Paul McCartney</li>  
13.     <li>George Harrison</li>  
14.     <li>Ringo Starr</li>  
15.   </ol>  
-----Lines 16 through 17 Omitted-----
```

The following screenshot shows how the code will be rendered.



❖ 6.2.1. Nesting Ordered Lists

Like unordered lists, ordered lists can be nested. However, unlike in some word processing applications, nested ordered lists will continue to be displayed using standard numbers:

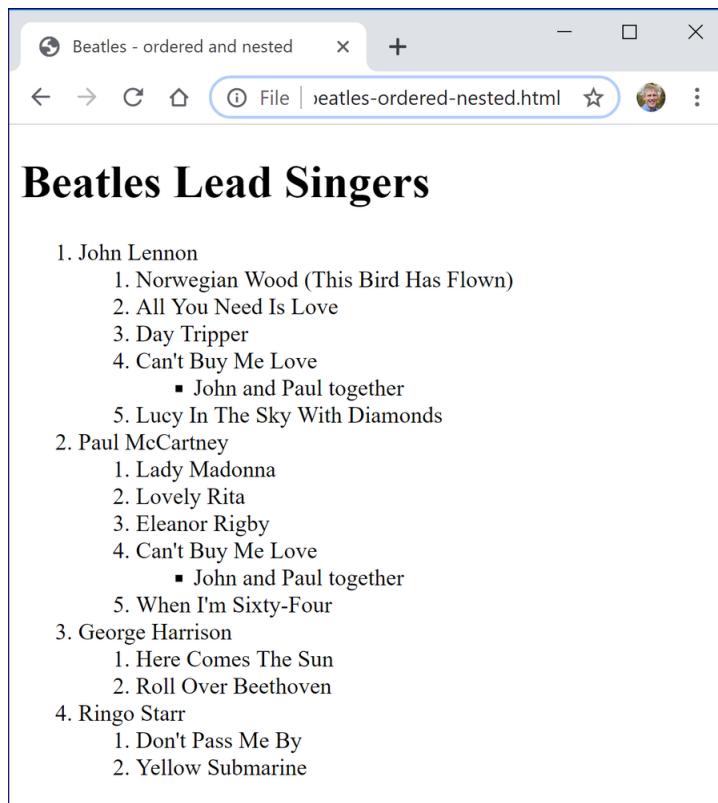
Demo 6.4: Lists/Demos/beatles-ordered-nested.html

-----Lines 1 through 8 Omitted-----

```
9.      <h1>Beatles Lead Singers</h1>
10.     <ol>
11.       <li>John Lennon
12.         <ol>
13.           <li>Norwegian Wood (This Bird Has Flown)</li>
14.           <li>All You Need Is Love</li>
15.           <li>Day Tripper</li>
16.           <li>Can't Buy Me Love
17.             <ul>
18.               <li>John and Paul together</li>
19.             </ul>
20.           </li>
21.           <li>Lucy In The Sky With Diamonds</li>
22.         </ol>
23.       </li>
24.       <li>Paul McCartney
25.         <ol>
26.           <li>Lady Madonna</li>
27.           <li>Lovely Rita</li>
28.           <li>Eleanor Rigby</li>
29.           <li>Can't Buy Me Love
30.             <ul>
31.               <li>John and Paul together</li>
32.             </ul>
33.           </li>
34.           <li>When I'm Sixty-Four</li>
35.         </ol>
36.       </li>
37.       <li>George Harrison
38.         <ol>
39.           <li>Here Comes The Sun</li>
40.           <li>Roll Over Beethoven</li>
41.         </ol>
42.       </li>
43.       <li>Ringo Starr
44.         <ol>
45.           <li>Don't Pass Me By</li>
46.           <li>Yellow Submarine</li>
47.         </ol>
48.       </li>
49.     </ol>
```

-----Lines 50 through 51 Omitted-----

The resulting page looks like this:



A screenshot of a web browser window titled "Beatles - ordered and nested". The address bar shows the file path "File | beatles-ordered-nested.html". The main content area displays a heading "Beatles Lead Singers" followed by a numbered list of lead singers and their respective songs. The list includes nesting, such as under "Can't Buy Me Love".

```
<ol style="list-style-type: none;">- 1. John Lennon
1. Norwegian Wood (This Bird Has Flown)
2. All You Need Is Love
3. Day Tripper
4. Can't Buy Me Love
  - John and Paul together
5. Lucy In The Sky With Diamonds
- 2. Paul McCartney
1. Lady Madonna
2. Lovely Rita
3. Eleanor Rigby
4. Can't Buy Me Love
  - John and Paul together
5. When I'm Sixty-Four
- 3. George Harrison
1. Here Comes The Sun
2. Roll Over Beethoven
- 4. Ringo Starr
1. Don't Pass Me By
2. Yellow Submarine

```

As you can see, ordered lists can contain nested unordered lists (below Can't Buy Me Love). The reverse is also true.

❖ 6.2.2. The type Attribute

The `type` attribute is used to change the numbering type. Possible values are shown in the following table:

Values of the type Attribute

| Value | Description |
|-------|--------------------------|
| i | Lowercase Roman Numerals |
| I | Uppercase Roman Numerals |
| a | Lowercase Letters |
| A | Uppercase Letters |
| 1 | Numbers (default) |

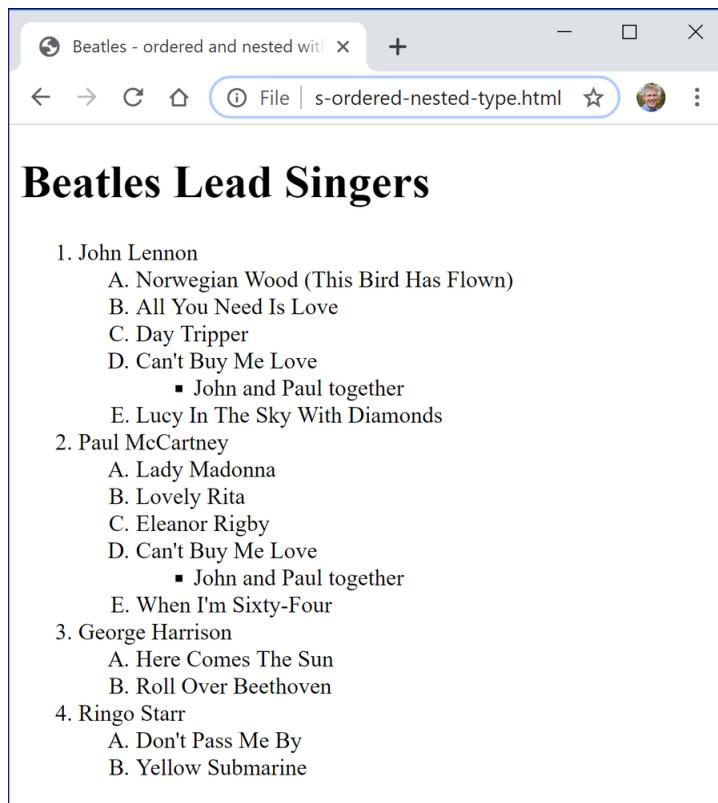
The following code illustrates how `type` is used:

Demo 6.5: Lists/Demos/beatles-ordered-nested-type.html

```
-----Lines 1 through 9 Omitted-----  
10.   <ol>  
11.     <li>John Lennon  
12.       <ol type="A">  
13.         <li>Norwegian Wood (This Bird Has Flown)</li>  
14.         <li>All You Need Is Love</li>  
15.         <li>Day Tripper</li>  
16.         <li>Can't Buy Me Love  
17.           <ul>  
18.             <li>John and Paul together</li>  
19.           </ul>  
20.         </li>  
21.         <li>Lucy In The Sky With Diamonds</li>  
22.       </ol>  
23.     </li>  
24.     <li>Paul McCartney  
25.       <ol type="A">  
26.         <li>Lady Madonna</li>  
27.         <li>Lovely Rita</li>  
28.         <li>Eleanor Rigby</li>  
29.         <li>Can't Buy Me Love  
30.           <ul>  
31.             <li>John and Paul together</li>  
32.           </ul>  
33.         </li>  
34.         <li>When I'm Sixty-Four</li>  
35.       </ol>  
36.     </li>  
37.     <li>George Harrison  
38.       <ol type="A">  
39.         <li>Here Comes The Sun</li>  
40.         <li>Roll Over Beethoven</li>  
41.       </ol>  
42.     </li>  
43.     <li>Ringo Starr  
44.       <ol type="A">  
45.         <li>Don't Pass Me By</li>  
46.         <li>Yellow Submarine</li>  
47.       </ol>  
48.     </li>  
49.   </ol>  
-----Lines 50 through 51 Omitted-----
```

Evaluation
Copy

Here is the resulting page:



The screenshot shows a web browser window titled "Beatles - ordered and nested with". The address bar displays "File | s-ordered-nested-type.html". The main content area features a heading "Beatles Lead Singers" followed by a nested list of songs:

- 1. John Lennon
 - A. Norwegian Wood (This Bird Has Flown)
 - B. All You Need Is Love
 - C. Day Tripper
 - D. Can't Buy Me Love
 - John and Paul together
 - E. Lucy In The Sky With Diamonds
- 2. Paul McCartney
 - A. Lady Madonna
 - B. Lovely Rita
 - C. Eleanor Rigby
 - D. Can't Buy Me Love
 - John and Paul together
 - E. When I'm Sixty-Four
- 3. George Harrison
 - A. Here Comes The Sun
 - B. Roll Over Beethoven
- 4. Ringo Starr
 - A. Don't Pass Me By
 - B. Yellow Submarine

List Types and CSS

As a rule, it is better to set the type of numbering using the CSS `list-style-type` property. The exception is when the value of the list item is meaningful as it sometimes is in legal or technical documents. This is because you cannot be sure that CSS will be enabled.

Also note that the unordered tag (``) used to have a `type` attribute as well, but this has been deprecated in favor of CSS, so you should not use it.

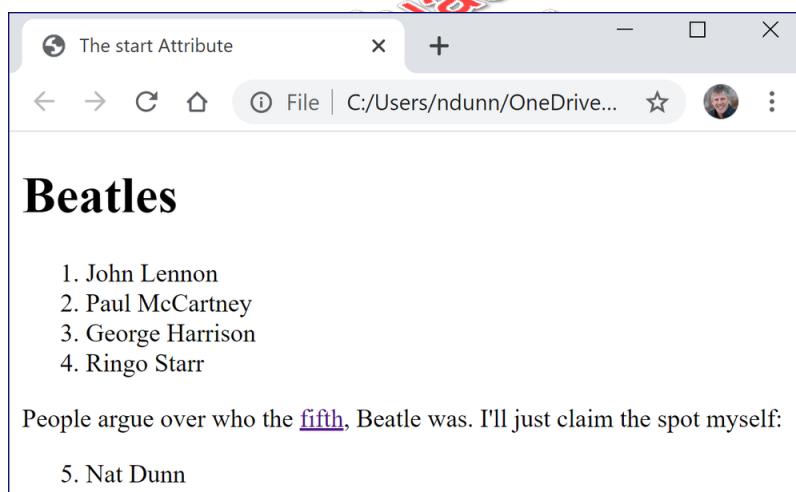
❖ 6.2.3. The start Attribute

The `start` attribute is used to specify what number the list should start on. It takes an integer value. For example:

Demo 6.6: Lists/Demos/fifth-beatle.html

```
-----Lines 1 through 9 Omitted-----  
10.   <ol>  
11.     <li>John Lennon</li>  
12.     <li>Paul McCartney</li>  
13.     <li>George Harrison</li>  
14.     <li>Ringo Starr</li>  
15.   </ol>  
16.   <p>  
17.     People argue over who the  
18.     <a href="https://en.wikipedia.org/wiki/Fifth_Beatle">fifth</a>,  
19.     Beatle was. I'll just claim the spot myself:  
20.   </p>  
21.   <ol start="5">  
22.     <li>Nat Dunn</li>  
23.   </ol>  
-----Lines 24 through 25 Omitted-----
```

The following screenshot shows how the code will be rendered:



*

6.3. Definition Lists

Definition lists are used to define a list of terms. The following example is a modified version of an example from the W3C Recommendation:¹⁹

19. <https://www.w3.org/TR/html4/struct/lists.html#edef-DD>

Demo 6.7: Lists/Demos/definition-list.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Definition List</title>
7.  </head>
8.  <body>
9.    <h1>Definition List</h1>
10.   <dl>
11.     <dt><dfn>Dweeb</dfn> (n.)</dt>
12.     <dd>young excitable person who may mature into a
13.       <em>Nerd</em> or <em>Geek</em></dd>
14.     <dt><dfn>Hacker</dfn> (n.)</dt>
15.     <dd>a clever programmer</dd>
16.     <dt><dfn>Nerd</dfn> (n.)</dt>
17.     <dd>technically bright but socially inept person</dd>
18.   </dl>
19. </body>
20. </html>
```

1. The `<dl>` tag contains the **definition list**.
2. The `<dt>` tags contain the **definition terms**. Notice that these contain `<dfn></dfn>` tags, which are used to indicate the term being defined.
3. The `<dd>` tags contain the **definition descriptions**.

The following screenshot shows how the code will be rendered:

A screenshot of a web browser window titled "Definition List". The address bar shows the URL "File | s/definition-list.html". The main content area displays a definition list:

- Dweeb** (n.)
young excitable person who may mature into a *Nerd* or *Geek*
- Hacker** (n.)
a clever programmer
- Nerd** (n.)
technically bright but socially inept person

Exercise 6: Creating Lists

 40 to 60 minutes

In this exercise, you will add several lists to the **Runners Home** website.

Navigation Menu

On all the pages, you will update the main navigation at the top to look like this:

Runners Home

- [Home](#)
- [Resources](#)
 - [Calculator](#)
 - [Running Log](#)
 - [Running Terms](#)
 - [Links](#)
- [Running Advice](#)
- [Races](#)
- [Register](#)

Notice that there is a nested list under **Resources**.

In addition to the main navigation list, add the following lists:

1. `index.html` – Add an ordered list under **Purpose** on the home page:

Purpose

Runners Home is dedicated to providing you with:

1. [the most up-to-date information on running races.](#)
2. [the best resources for runners.](#)

2. `races.html` – Add an ordered list with nested unordered lists to the page:

Races

1. [AJC Peachtree Road Race](#)
 - **Date:** March 15th
 - **Distance:** 10K
 - **Location:** Atlanta, GA
2. [Boilermaker](#)
 - **Date:** July 11th
 - **Distance:** 15K
 - **Location:** Utica, NY
3. [NYC Marathon](#)
 - **Date:** November 3rd
 - **Distance:** 26.22 mi
 - **Location:** New York, NY

3. resources/index.html – Add an unordered list:

Resources

- [Calculator](#)
- [Running Log](#)
- [Running Terms](#)
- [Links](#)

4. resources/terms.html – Add a definition list to the page:

Running Terms

Aerobic

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam et gravida sapien, facilisis condimentum arcu. Morbi eget dui iaculis, porttitor eros et, tincidunt erat...

Bandit

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam et gravida sapien, facilisis condimentum arcu. Morbi eget dui iaculis, porttitor eros et, tincidunt erat...

C25K

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam et gravida sapien, facilisis condimentum arcu. Morbi eget dui iaculis, porttitor eros et, tincidunt erat...

DNF

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam et gravida sapien, facilisis condimentum arcu. Morbi eget dui iaculis, porttitor eros et, tincidunt erat...

Easy Run

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam et gravida sapien, facilisis condimentum arcu. Morbi eget dui iaculis, porttitor eros et, tincidunt erat...

5. resources/links.html – Add an unordered list to the page:



Useful Links

- [Map My Run](#)
- [Runners World](#)
- [Strength Running](#)

6. advice/index.html – Add an unordered list to the page:



Running Advice

- [Running Tips](#)
- [Health Tips](#)

Solution: Lists/Solutions/index.html

```
-----Lines 1 through 11 Omitted-----
12. <h1>Runners Home</h1>
13. <ul>
14.   <li><a href="index.html">Home</a></li>
15.   <li><a href="resources/index.html">Resources</a>
16.     <ul>
17.       <li><a href="resources/calculator.html">Calculator</a></li>
18.       <li><a href="resources/run-log.html">Running Log</a></li>
19.       <li><a href="resources/terms.html">Running Terms</a></li>
20.       <li><a href="resources/links.html">Links</a></li>
21.     </ul>
22.   </li>
23.   <li><a href="advice/index.html">Running Advice</a></li>
24.   <li><a href="races.html">Races</a></li>THE  
EVALUATION  
COPY
25.   <li><a href="register.html">Register</a></li>
26. </ul>
-----Lines 27 through 46 Omitted-----
47. <h2>Purpose</h2>
48. <p>Runners Home is dedicated to providing you with:</p>
49. <ol>
50.   <li><a href="races.html">the most up-to-date
51.     information on running races</a>.</li>
52.   <li><a href="resources/index.html">the best
53.     resources for runners</a>.</li>
54. </ol>
-----Lines 55 through 68 Omitted-----
```

The main navigation list should be included on all the pages. That is not shown in the solutions below.

Solution: Lists/Solutions/races.html

-----Lines 1 through 26 Omitted-----

```
27. <h2>Races</h2>
28. <ol>
29.   <li>
30.     <a href="https://www.atlantatrackclub.org/peachtree">
31.       AJC Peachtree Road Race
32.     </a>
33.     <ul>
34.       <li><strong>Date</strong>: March 15th</li>
35.       <li><strong>Distance</strong>: 10K</li>
36.       <li><strong>Location</strong>: Atlanta, GA</li>
37.     </ul>
38.   </li>
39.   <li>
40.     <a href="https://www.boilermaker.com">Boilermaker</a>
41.     <ul>
42.       <li><strong>Date</strong>: July 11th</li>
43.       <li><strong>Distance</strong>: 15K</li>
44.       <li><strong>Location</strong>: Utica, NY</li>
45.     </ul>
46.   </li>
47.   <li>
48.     <a href="https://www.nyrr.org/">NYC Marathon</a>
49.     <ul>
50.       <li><strong>Date</strong>: November 3rd</li>
51.       <li><strong>Distance</strong>: 26.22 mi</li>
52.       <li><strong>Location</strong>: New York, NY</li>
53.     </ul>
54.   </li>
55. </ol>
```

-----Lines 56 through 69 Omitted-----

Solution: Lists/Solutions/resources/index.html

```
-----Lines 1 through 26 Omitted-----  
27. <h2>Resources</h2>  
28. <ul>  
29.   <li><a href="calculator.html">Calculator</a></li>  
30.   <li><a href="run-log.html">Running Log</a></li>  
31.   <li><a href="terms.html">Running Terms</a></li>  
32.   <li><a href="links.html">Links</a></li>  
33. </ul>  
-----Lines 34 through 47 Omitted-----
```

Solution: Lists/Solutions/resources/terms.html

-----Lines 1 through 26 Omitted-----

```
27. <h2>Running Terms</h2>  
28. <dl>  
29.   <dt id="aerobic">Aerobic</dt>  
30.   <dd>Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
31.     Aliquam et gravida sapien, facilisis condimentum arcu.  
32.     Morbi eget dui iaculis, porttitor eros et, tincidunt erat...</dd>  
33.  
34.   <dt id="bandit">Bandit</dt>  
35.   <dd>Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
36.     Aliquam et gravida sapien, facilisis condimentum arcu.  
37.     Morbi eget dui iaculis, porttitor eros et, tincidunt erat...</dd>  
38.  
39.   <dt id="C25K"><abbr title="couch to 5K">C25K</abbr></dt>  
40.   <dd>Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
41.     Aliquam et gravida sapien, facilisis condimentum arcu.  
42.     Morbi eget dui iaculis, porttitor eros et, tincidunt erat...</dd>  
43.  
44.   <dt id="dnf"><abbr title="Did not finish">DNF</abbr></dt>  
45.   <dd>Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
46.     Aliquam et gravida sapien, facilisis condimentum arcu.  
47.     Morbi eget dui iaculis, porttitor eros et, tincidunt erat...</dd>  
48.  
49.   <dt id="easy-run">Easy Run</dt>  
50.   <dd>Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
51.     Aliquam et gravida sapien, facilisis condimentum arcu.  
52.     Morbi eget dui iaculis, porttitor eros et, tincidunt erat...</dd>  
53. </dl>  
-----Lines 54 through 68 Omitted-----
```

Solution: Lists/Solutions/resources/links.html

```
-----Lines 1 through 26 Omitted-----  
27. <h2>Useful Links</h2>  
28. <ul>  
29.   <li><a href="https://www.mapmyrun.com/">Map My Run</a></li>  
30.   <li><a href="https://www.runnersworld.com">Runners World</a></li>  
31.   <li><a href="https://strengthrunning.com/">Strength Running</a></li>  
32. </ul>  
-----Lines 33 through 47 Omitted-----
```

Solution: Lists/Solutions/advice/index.html

*Evaluation
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```
-----Lines 1 through 26 Omitted-----  
27. <h2>Running Advice</h2>  
28. <ul>  
29.   <li><a href="running-tips.html">Running Tips</a></li>  
30.   <li><a href="health-tips.html">Health Tips</a></li>  
31. </ul>  
-----Lines 32 through 45 Omitted-----
```

Conclusion

In this lesson, you have learned to create unordered, ordered and definition lists.

LESSON 7

Crash Course in CSS

Topics Covered

- Benefits of Cascading Style Sheets.
- Redefining how elements are formatted.
- CSS selectors.
- CSS combinators.
- The CSS cascade.
- CSS resets and normalizers.
- External stylesheets, embedded stylesheets, and inline styles.
- The div and span elements.
- Media types.
- The viewport <meta> tag.
- Units of measurement.
- How browsers style pages.
- Inheritance.

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Introduction

Since HTML 4.0, most HTML formatting elements (e.g., `center` for centering content) and attributes (e.g., `bgcolor` for background color) have been deprecated, meaning that, although they may still be supported by browsers, the WHATWG (the maintainer of the HTML specification) recommends that they no longer be used. Web designers are to use CSS instead. In this lesson, you will get a high-level overview of CSS.



7.1. Benefits of Cascading Style Sheets

The major benefits of CSS are:

1. Cleaner Code

- Easier to maintain.
- Speedier download.
- Better for search engine optimization.

2. Modular Code

- Style rules can be applied to multiple pages.
- Consistency of design.
- Easier to maintain.

3. Design Power

- Precise control of position, size, margins, etc.

4. Division of Labor

- Developers develop / Designers design.

5. Better Accessibility²⁰

- No need to misuse tags (e.g., `<blockquote>` for formatting).
- No need for invisible images for positioning.
- Users' stylesheets override authors' styles.



7.2. CSS Rules

CSS *rules* are statements that define the style of an element or group of elements. The syntax is as follows:

20. See <https://www.w3.org/TR/CSS-access>.

```
selector {  
    property: value;  
    property: value;  
    property: value;  
}
```

Each *property: value* pair is a *declaration*. Multiple declarations are separated by semicolons. The *selector* defines which elements are affected by the rule. Take a look at the following rule:

```
p {  
    color: darkgreen;  
    font-family: Verdana;  
    font-size: 1.5em;  
}
```

This rule specifies that all paragraph text should be darkgreen and use a 1.5em Verdana font. That's one and a half times the size that the font would normally be. You will learn about units of measurement soon.

❖ 7.2.1. CSS Comments

Comments in CSS begin with “/*” and end with “*/”. See the example below:

```
p {  
    color: red; /* All paragraphs should be red */  
}
```



7.3. Selectors

Selectors identify the element(s) affected by the CSS rule. There are several types of selectors:

1. Type
2. Class
3. ID
4. Attribute
5. Universal

In this section, we will give a high-level explanation of each of these types of selectors. It is a lot of information all at once. You should read through this section slowly and carefully. While it is important that you have an understanding of the different types of selectors, you do not need to commit the syntax for each type to memory. That will happen over time as you use them in practice.

❖ 7.3.1. Type Selectors

Type selectors specify elements by tag name and affect every instance of that element type. Looking again at the previous example:

```
p {  
    color: darkgreen;  
    font-family: Verdana;  
    font-size: 1.5em;  
}
```

Again, this rule specifies that the text of **every** p element should be darkgreen and use a 1.5em Verdana font.

❖ 7.3.2. Class Selectors

In HTML, all elements can take the `class` attribute, which is used to assign one or more class names to an element. The names given to classes are arbitrary, but should be descriptive of the purpose of the class. In CSS, class selectors begin with a dot. For example, the following rule specifies that any elements with the class “warning” should be bold and red:

```
.warning {  
    color: red;  
    font-weight: bold;  
}
```

Following are a couple of examples of elements of the “warning” class:

```
<h1 class="warning">WARNING</h1>  
<p class="warning">Don't go there!</p>
```

If the class selector is preceded by an element name, then that selector only applies to the specified type of element. To illustrate, the following two rules indicate that h1 elements of the class “warning” will be underlined, while p elements of the class “warning” will not be:

```
h1.warning {
  color: red;
  text-decoration: underline;
}

p.warning {
  color: red;
  font-weight: bold;
}
```

Because both rules indicate that the color should be red, this could be rewritten as follows:

```
.warning {
  color: red;
}

h1.warning {
  text-decoration: underline;
}

p.warning {
  font-weight: bold;
}
```

Note that you can assign an element any number of classes simply by separating the class names with spaces like this:

```
<div class="class1 class2 class3">...
```

❖ 7.3.3. ID Selectors

As with the `class` attribute, in HTML, all elements can take the `id` attribute, which is used to uniquely identify an element on the page. In CSS, ID selectors begin with a number sign (#) and have arbitrary names. The following rule will give the element with the “main-text” `id` a margin of `1.2em` on the left and right:

```
#main-text {  
    margin-left: 1.2em;  
    margin-right: 1.2em;  
}  
  
<div id="main-text">  
    <p>This is the main text of the page...</p>  
</div>
```

❖ 7.3.4. Attribute Selectors

Attribute selectors specify elements that contain a specific attribute. They can also specify what the value of that attribute should or should not be.

The following selector affects all links with a `target` attribute:

```
a[target] {  
    color: red;  
}
```

The `=` (equals) operator can be used to specify the attribute value. The following selector would only affect links whose `target` attribute is exactly “`_blank`”:

```
a[target='_blank'] {  
    color: red;  
}
```

You can get much more specific about attribute values...

The `^=` (starts-with) operator can be used to specify the beginning text of the attribute value. The following selector will only affect links whose `href` attribute starts with “`mailto`”:

```
a[href^='mailto'] {  
    color: red;  
}
```

The `$=` (ends-with) operator can be used to specify the ending text of the attribute value. The following selector will only affect links whose `class` attribute ends with “`link`”:

```
a[class$='link'] {  
    color: red;  
}
```

The *= (contains) operator can be used to specify text the attribute value must contain. The following selector will only affect links whose class attribute contains “top”:

```
a[class*='top'] {  
    color: red;  
}
```

❖ 7.3.5. The Universal Selector

The universal selector is an asterisk (*). It matches every element:

```
* {  
    color: red;  
}
```

❖ 7.3.6. Grouping

Selectors can share the same declarations by separating them with commas. The following rule will underline all em elements, all elements of the class “warning” and the element with the id of “important”:

```
em,  
.warning,  
#important {  
    text-decoration: underline;  
}
```



7.4. Combinators

Combinators allow for the selection of elements based on the relationships between selectors.

There are several types of combinators:

1. Descendant
2. Child
3. General sibling
4. Adjacent sibling

❖ 7.4.1. Descendant Combinators

Descendant combinators specify elements by ancestry. Each “generation” is separated by a space. For example, the following rule states that **strong** elements within **p** elements should have red text:

```
p strong {  
    color: red;  
}
```

With descendant selectors, generations can be skipped. In other words, the code above does not require that the **strong** element is a direct child of the **p** element.

❖ 7.4.2. Child Combinators

Child combinators specify a direct parent-child relationship. They are indicated by placing a **>** sign between the two element names:

```
p > strong {  
    color: red;  
}
```

In this case only **strong** elements that are direct children of **p** elements are affected.

❖ 7.4.3. General Sibling Combinators

General sibling combinators specify a sibling relationship²¹ between two elements where the second element specified comes after the first. They are indicated by placing a **~** sign between the two element names:

21. Sibling elements have the same parent element.

```
em ~ strong {  
    color: red;  
}
```

In this case only `strong` elements that are siblings of and follow `em` elements are affected. For example, in the following code: both `strong` elements would be red:

```
<em>Hello!</em>  
<strong>Hi there!</strong>  
I'm not in a strong or em element.  
<strong>Howdy!</strong>
```

❖ 7.4.4. Adjacent Sibling Combinators

Adjacent sibling combinator specify a sibling relationship between two elements where the second element specified comes *immediately* after the first. They are indicated by placing a + sign between the two element names:

```
em + strong {  
    color: red;  
}
```

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In this case only `strong` elements that are siblings of and immediately follow `em` elements are affected. In the HTML code just shown above, only the first `strong` element (with the text “Hi there!”) would be red, because it immediately follows an `em` element.



7.5. Precedence of Selectors

In the event that rules conflict:

- The rule with the more specific selector takes precedence.
- If two selectors have the same specificity, the rule specified later in the document takes precedence.

`!important`

Adding `!important` to any CSS declaration will give that declaration the highest specificity, but using `!important` is bad practice, and should be avoided.²²

Evaluation
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7.6. How Browsers Style Pages

Browsers have built-in styles to make web pages readable by default (i.e., without CSS). Without any styles, an HTML page would just be one big line of text. For example, look at the code below:

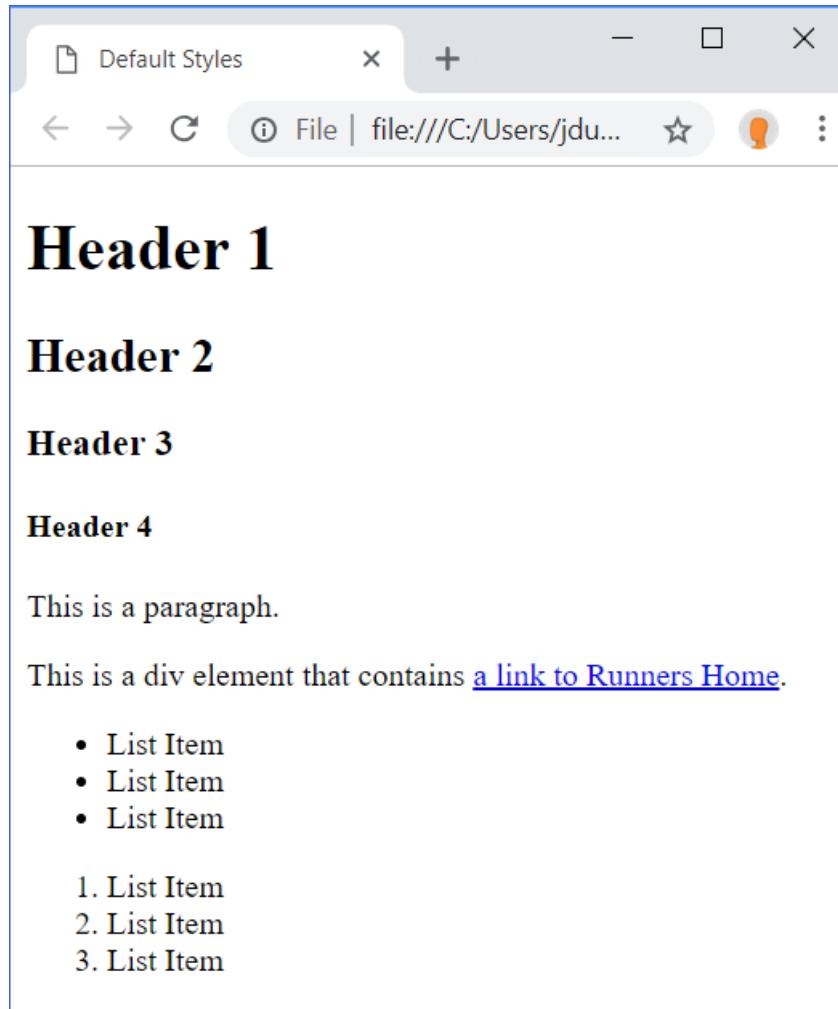
^{22.} See https://developer.mozilla.org/en-US/docs/Web/CSS/Specificity#the_!important_exception.

Demo 7.1: CrashCourse/Demos/default-styles.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <title>Default Styles</title>
7.  </head>
8.  <body>
9.    <h1>Header 1</h1>
10.   <h2>Header 2</h2>
11.   <h3>Header 3</h3>
12.   <h4>Header 4</h4>
13.   <p>This is a paragraph.</p>
14.   <div>This is a div element that contains
15.     <a href="https://www.runners-home.com">a link to Runners Home</a>.
16.   </div>
17.   <ul>
18.     <li>List Item</li>
19.     <li>List Item</li>
20.     <li>List Item</li>
21.   </ul>
22.   <ol>
23.     <li>List Item</li>
24.     <li>List Item</li>
25.     <li>List Item</li>
26.   </ol>
27. </body>
28. </html>
```

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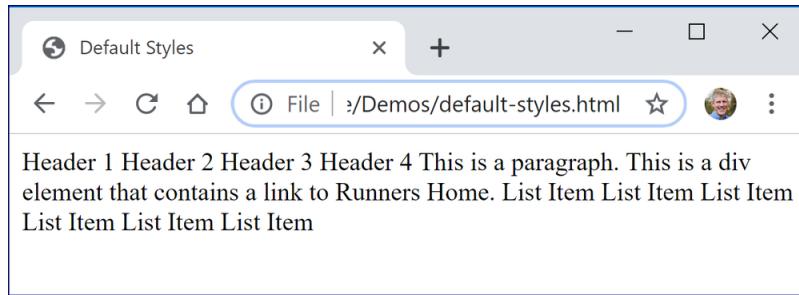
To make pages readable by default, the browsers add styles to render the page like this:



Notice the default styles:

1. The headings are bold, have varying font sizes, and have margin before and after them.
2. All of the elements, except the link, are on their own blocks as if they had `
` tags before and after them.
3. The unordered and ordered lists come with bullets and numbers, respectively.
4. The link is blue and underlined.

If browsers did not have default styles, they would display all the text in the body along a single line like this:



As that's not very readable, it's a good thing that browsers do provide default styles. Unfortunately, not all browsers provide the same default styles for all elements, so it's common practice for web designers to remove or override the browsers' default styles with default styles of their own.

Evaluation
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7.7. CSS Resets

CSS resets are used to remove most default styles that browsers add to HTML elements, so that designers can decide on these styles themselves. For example, after applying a CSS reset, header tags will no longer be big and bold. By resetting the default styles, the designer gets rid of inconsistencies between browser default styles, opening the door for them to add styles that are rendered the same by all browsers.

A common CSS reset is the Meyer Reset²³, which you can see below:

23. <https://meyerweb.com/eric/tools/css/reset/>

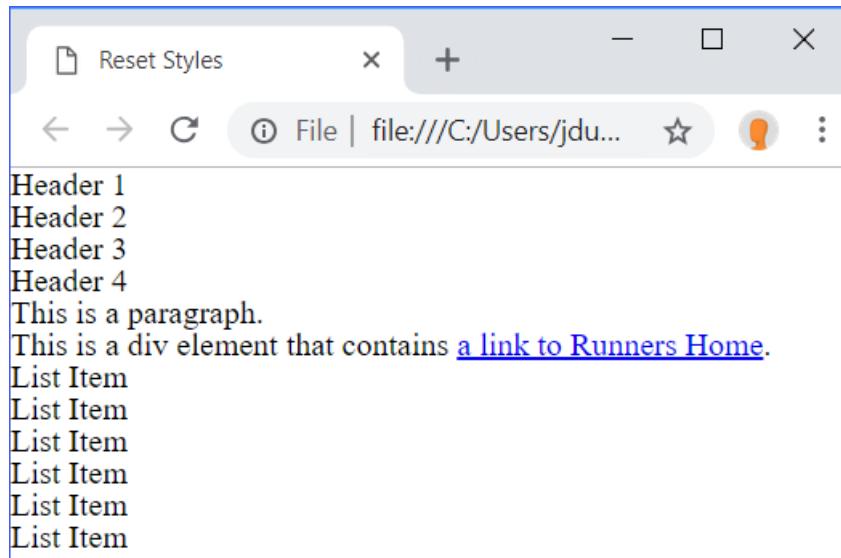
Demo 7.2: CrashCourse/Demos/reset.css

```
1. /* http://meyerweb.com/eric/tools/css/reset/
2.      v2.0 | 20110126
3.      License: none (public domain)
4. */
5.
6. html, body, div, span, applet, object, iframe,
7. h1, h2, h3, h4, h5, h6, p, blockquote, pre,
8. a, abbr, acronym, address, big, cite, code,
9. del, dfn, em, img, ins, kbd, q, s, samp,
10. small, strike, strong, sub, sup, tt, var,
11. b, u, i, center,
12. dl, dt, dd, ol, ul, li,
13. fieldset, form, label, legend,
14. table, caption, tbody, tfoot, thead, tr, th, td,
15. article, aside, canvas, details, embed,
16. figure, figcaption, footer, header, hgroup,
17. menu, nav, output, ruby, section, summary,
18. time, mark, audio, video {
19.     margin: 0;
20.     padding: 0;
21.     border: 0;
22.     font-size: 100%;
23.     font: inherit;
24.     vertical-align: baseline;
25. }
26. /* HTML5 display-role reset for older browsers */
27. article, aside, details, figcaption, figure,
28. footer, header, hgroup, menu, nav, section {
29.     display: block;
30. }
31. body {
32.     line-height: 1;
33. }
34. ol, ul {
35.     list-style: none;
36. }
37. blockquote, q {
38.     quotes: none;
39. }
40. blockquote:before, blockquote:after,
41. q:before, q:after {
42.     content: '';
43.     content: none;
44. }
```

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```
45. table {  
46.   border-collapse: collapse;  
47.   border-spacing: 0;  
48. }
```

Attaching this stylesheet to `default-styles.html` will render the page like this:



*

7.8. CSS Normalizers

CSS normalizers are slightly different from CSS resets. Instead of getting rid of all styles, they adjust styles so that they are consistent between browsers. In doing so, normalizers have to choose some styles over others. As such, normalizers are *opinionated*, meaning that the authors of these normalizers have made design choices based on their own preferences. For the rest of this course, we will be using a slightly modified version of a normalizer called `normalize.css`²⁴ in all of our files.

²⁴. <https://necolas.github.io/normalize.css/>

Normalize

`normalize.css` is the normalizer used by Bootstrap²⁵, a popular open source toolkit for developing web pages, to improve cross-browser rendering.



7.9. External Stylesheets, Embedded Stylesheets, and Inline Styles

❖ 7.9.1. External Stylesheets

External stylesheets are created in separate documents with a `.css` extension. An external stylesheet is simply a listing of rules. It cannot contain HTML tags. Throughout this course, we will mainly be working with external stylesheets. `CrashCourse/Demos/styles.css` is an example of an external stylesheet.

Demo 7.3: CrashCourse/Demos/styles.css

```
1. .warning {  
2.   color: red;  
3. }  
4.  
5. h1.warning {  
6.   text-decoration: underline;  
7. }  
8.  
9. p.warning {  
10.   font-weight: bold;  
11. }
```

The above CSS file can be included in any number of HTML pages using the `<link>` tag, which usually goes in the head of an HTML page:

25. <https://getbootstrap.com>

```
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width,initial-scale=1">
<link href="styles.css" rel="stylesheet">
<title>Page Title</title>
</head>
```

<link> Attributes

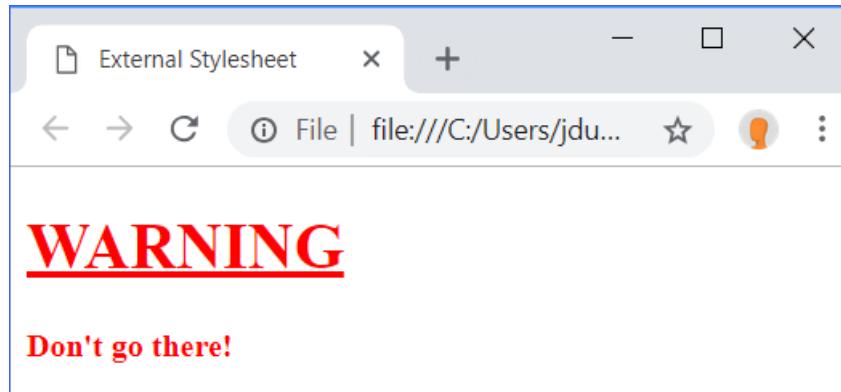
- `href` - points to the location of the external stylesheet.
- `rel` - must be set to “stylesheet” for linking stylesheets.

Notice the `<link>` tag in the code below that links to `styles.css`:

Demo 7.4: CrashCourse/Demos/external-stylesheet.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link href="../normalize.css" rel="stylesheet">
7.  <link href="styles.css" rel="stylesheet">
8.  <title>External Stylesheet</title>
9.  </head>
10. <body class="webucator">
11.   <h1 class="warning">WARNING</h1>
12.   <p class="warning">Don't go there!</p>
13. </body>
14. </html>
```

This page will render as follows:



There is no limit to the number of external stylesheets a single HTML page can use. Notice in the preceding example that we linked to two external stylesheets:

```
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width,initial-scale=1">
<link href="../normalize.css" rel="stylesheet">
<link href="styles.css" rel="stylesheet">
<title>External Stylesheet</title>
</head>
```

Also, as you will see, external stylesheets can be combined with embedded stylesheets and inline styles.

❖ 7.9.2. Embedded Stylesheets

Embedded stylesheets appear in the `style` element, which usually goes in the head of an HTML page. The code below shows a page with an embedded stylesheet:

Demo 7.5: CrashCourse/Demos/embedded-stylesheet.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link href="../normalize.css" rel="stylesheet">
7.  <style>
8.      .warning {
9.          color: red;
10.     }
11.
12.     h1.warning {
13.         text-decoration: underline;
14.     }
15.
16.     p.warning {
17.         font-weight: bold;
18.     }
19. </style>
20. <title>Embedded Stylesheet</title>
21. </head>
22. <body class="webucator">
23.     <h1 class="warning">WARNING</h1>
24.     <p class="warning">Don't go there!</p>
25. </body>
26. </html>
```

This page will render the same as the HTML page with the external stylesheet.

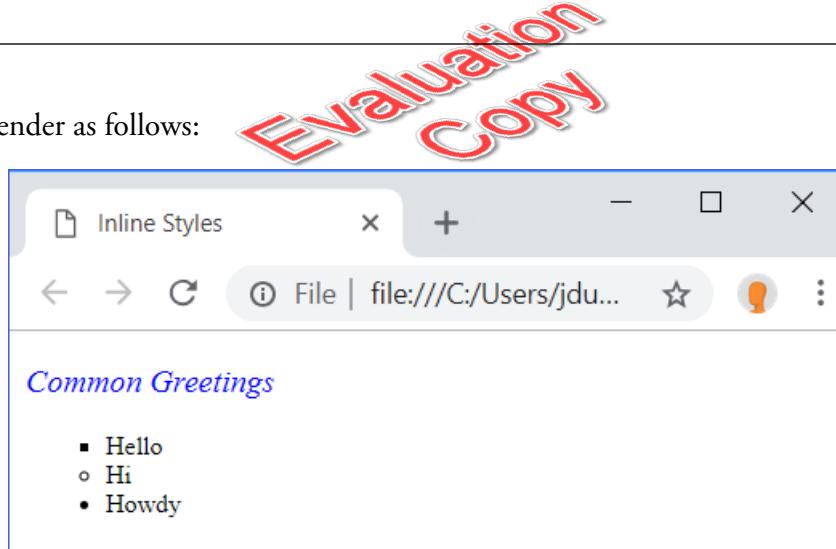
❖ 7.9.3. Inline Styles

Inline styles are created by adding the `style` attribute to a tag. As with the `class` and `id` attributes, all elements can take the `style` attribute. The value of the `style` attribute is a list of one or more declarations separated by semicolons. The code sample below illustrates how inline styles are used:

Demo 7.6: CrashCourse/Demos/inline-styles.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link href="../normalize.css" rel="stylesheet">
7.  <title>Inline Styles</title>
8.  </head>
9.  <body class="webucator">
10. <p style="color: blue; font-style: italic; font-size: 1em;">
11.   Common Greetings
12. </p>
13. <ul style="font-size: 0.8em;">
14.   <li style="list-style-type: square;">Hello</li>
15.   <li style="list-style-type: circle;">Hi</li>
16.   <li style="list-style-type: disc;">Howdy</li>
17. </ul>
18. </body>
19. </html>
```

This page will render as follows:



Avoid Using Inline Styles

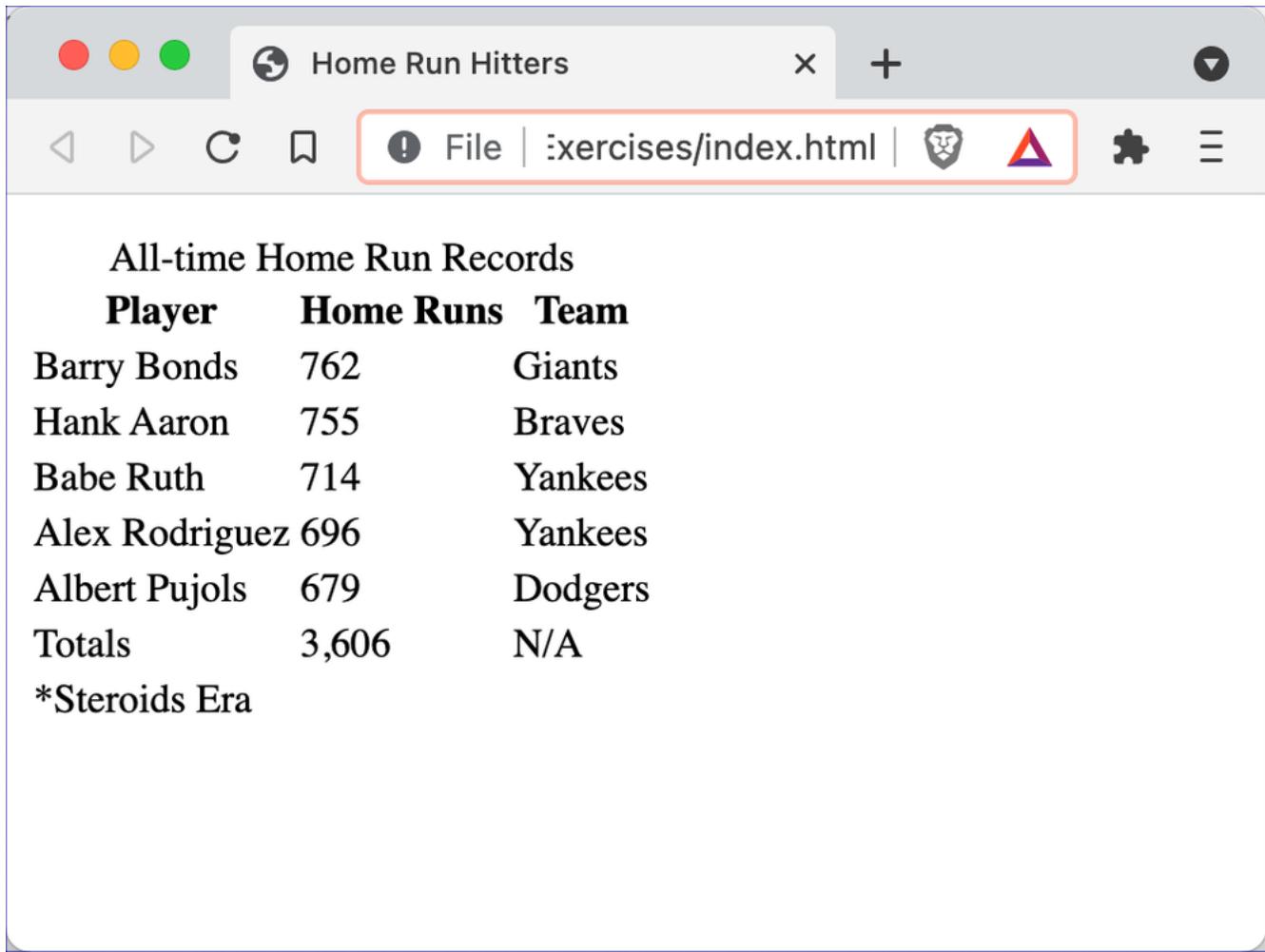
It is generally bad practice to use inline styles in production code; however, they can be useful for testing and debugging.

Exercise 7: Creating an External Stylesheet

⌚ 25 to 40 minutes

In this exercise, you will add several simple rules to an external stylesheet and link to it from `CrashCourse/Exercises/index-external-styles.html`. Do not worry about learning the CSS properties and values at this point. This exercise is just to give you some practice creating a stylesheet.

1. Open `CrashCourse/Exercises/index.html` in a browser. It should look like this:



The screenshot shows a web browser window titled "Home Run Hitters". The address bar displays the URL "File | Exercises/index.html". The main content area of the browser shows a table of all-time home run records. The table has columns for Player, Home Runs, and Team. The data is as follows:

| Player | Home Runs | Team |
|----------------|-----------|---------|
| Barry Bonds | 762 | Giants |
| Hank Aaron | 755 | Braves |
| Babe Ruth | 714 | Yankees |
| Alex Rodriguez | 696 | Yankees |
| Albert Pujols | 679 | Dodgers |
| Totals | 3,606 | N/A |

*Steroids Era

2. Open `CrashCourse/Exercises/index.html` in your editor and save it as `index-external-styles.html`.

3. Create a new file and save it as `styles.css` in the same directory.
4. Add a `<link>` tag with an `href` value of “`styles.css`” and a `rel` value of “`stylesheet`” in the head of `index-external-styles.html`.
5. In `styles.css`, add a rule for the `body` element that contains the following declarations:
 - `background-attachment: fixed;`
 - `background-image: url(images/baseball.png);`
 - `background-position: bottom;`
 - `background-repeat: repeat-x;`

For a refresher on how to add rules, refer to the **CSS Rules** section of this lesson (see page 102).

6. Add a rule for `table` elements that contains the following declarations:

- `background-color: white;`
- `border-collapse: collapse;`
- `margin: auto;`
- `min-width: 800px;`

7. Add a rule for `caption` elements that contains the following declaration:

- `font-style: italic;`

8. Add a rule for `thead` elements that contains the following declarations:

- `background-color: darkblue;`
- `color: white;`

9. Add a rule for `td` and `th` elements that contains the following declarations:

- `border: 1px solid orange;`
- `margin: 0;`
- `padding: .3em;`

For a refresher on adding a rule for multiple selectors, refer to **Grouping** within the **Selectors** section of this lesson (see page 107).

10. Add a rule for `td` elements that are in the `tfoot` that contains the following declarations:

- `background-color: silver;`
- `border-top: 2px solid black;`

- `font-weight: bold;`

For a refresher on adding a rule for an element that is contained within another element, refer to **Descendant Combinators** in the **Combinators** section of this lesson (see page 108).

11. Add a rule for elements with the “steroids-era” class that contains the following declaration:

- `font-style: italic;`

For a refresher on adding a rule for an element of a specific class, refer to the **Class Selectors** within the **Selectors** section of this lesson (see page 104).

12. Add a rule for the element with the “key” id that contains the following declarations:

- `background-color: lightgray;`
- `font-style: italic;`

For a refresher on adding a rule for an element of a specific id, refer to the **ID Selectors** within the **Selectors** section of this lesson (see page 105).

13. Add the following two rules to the bottom of `styles.css`:

```
tr td:nth-child(2) {  
    text-align: center;  
}  
  
.steroids-era td:first-child::after {  
    content: '*';  
}
```

Just add these last two rules exactly as written. Don’t worry about understanding the selectors yet. We will cover them in later lessons. For now, we just want you to see what CSS can do.

14. In `index-external-styles.html`:

- Assign a class of “steroids-era” to the table rows containing Barry Bonds and Alex Rodriguez.
- Assign an id of “key” to the table data cell in the `tfoot` that contains the text “*Steroids Era.”

15. Open `index-external-styles.html` in a browser. It should look like this:

Home Run Hitters

its/Webucator/CSS/CrashCourse/Solutions/index-embedded-styles.html

All-time Home Run Records

| Player | Home Runs | Team |
|-----------------|--------------|---------|
| Barry Bonds* | 762 | Giants |
| Hank Aaron | 755 | Braves |
| Babe Ruth | 714 | Yankees |
| Alex Rodriguez* | 696 | Yankees |
| Albert Pujols | 679 | Dodgers |
| Totals | 3,606 | N/A |

*Steroids Era



Solution: CrashCourse/Solutions/index-external-styles.html

```
-----Lines 1 through 6 Omitted-----
7. <link href="styles.css" rel="stylesheet">
8. <title>Home Run Hitters</title>
9. </head>
10. <body class="webucator">
11.   <table>
12.     <caption>All-time Home Run Records</caption>
13.     <thead>
14.       <tr>
15.         <th>Player</th>
16.         <th>Home Runs</th>
17.         <th>Team</th>
18.       </tr>
19.     </thead>
20.     <tbody>
21.       <tr class="steroids-era">
22.         <td>Barry Bonds</td>
23.         <td>762</td>
24.         <td>Giants</td>
25.       </tr>
-----Lines 26 through 35 Omitted-----
36.       <tr class="steroids-era">
37.         <td>Alex Rodriguez</td>
38.         <td>696</td>
39.         <td>Yankees</td>
40.       </tr>
-----Lines 41 through 52 Omitted-----
53.       <tr>
54.         <td colspan="3" id="key">*Steroids Era</td>
55.       </tr>
56.     </tfoot>
57.   </table>
58. </body>
59. </html>
```

Evaluation
Copy

Solution: CrashCourse/Solutions/styles.css

```
1. body {
2.   background-attachment: fixed;
3.   background-image: url(images/baseball.png);
4.   background-position: bottom;
5.   background-repeat: repeat-x;
6. }
7.
8. table {
9.   background-color: white;
10.  border-collapse: collapse;
11.  margin: auto;
12.  min-width: 800px;
13. }
14.
15. caption {
16.   font-style: italic;
17. }
18.
19. thead {
20.   background-color: darkblue;
21.   color: white;
22. }
23.
24. td,
25. th {
26.   border: 1px solid orange;
27.   margin: 0;
28.   padding: .3em;
29. }
30.
31. tfoot td {
32.   background-color: silver;
33.   border-top: 2px solid black;
34.   font-weight: bold;
35. }
36.
37. .asteroids-era {
38.   font-style: italic;
39. }
40.
41. #key {
42.   background-color: lightgray;
43.   font-style: italic;
44. }
```

Evaluation
Copy

```
45.  
46. tr td:nth-child(2) {  
47.   text-align: center;  
48. }  
49.  
50. .asteroids-era td:first-child::after {  
51.   content: '*';  
52. }
```

Evaluation
Copy

Exercise 8: Creating an Embedded Stylesheet

 5 to 10 minutes

In this exercise, you will replace your external stylesheet with an embedded stylesheet.

1. Open CrashCourse/Exercises/index-external-styles.html in your editor and save it as index-embedded-styles.html.
2. Remove the `<link>` tag, and add a `style` block.
3. Copy and paste all the CSS rules from `styles.css` to the `style` block in `index-embedded-styles.html`.
4. Open `index-embedded-styles.html` in a browser. It should look the same as `index-external-styles.html` did (see page 123).

Solution: CrashCourse/Solutions/index-embedded-styles.html

```
-----Lines 1 through 6 Omitted-----
7. <title>Home Run Hitters</title>
8. <style>
9.   body {
10.     background-attachment: fixed;
11.     background-image: url(images/baseball.png);
12.     background-position: bottom;
13.     background-repeat: repeat-x;
14.   }
15.
16.   table {
17.     background-color: white;
18.     border-collapse: collapse;
19.     margin: auto;
20.     min-width: 800px;
21.   }
22.
23.   caption {
24.     font-style: italic;
25.   }
26.
27.   thead {
28.     background-color: darkblue;
29.     color: white;
30.   }
31.
32.   td,
33.   th {
34.     border: 1px solid orange;
35.     margin: 0;
36.     padding: .3em;
37.   }
38.
39.   tfoot td {
40.     background-color: silver;
41.     border-top: 2px solid black;
42.     font-weight: bold;
43.   }
44.
45.   .steroids-era {
46.     font-style: italic;
47.   }
48.
49.   #key {
```

Evaluation
Copy

```
50.     background-color: lightgray;
51.     font-style: italic;
52. }
53.
54. tr td:nth-child(2) {
55.     text-align: center;
56. }
57.
58. .steroids-era td:first-child::after {
59.     content: '*';
60. }
61. </style>
62. </head>
```

-----Lines 63 through 112 Omitted-----



Exercise 9: Adding Inline Styles



10 to 20 minutes

In this exercise, you will add some inline styles.

1. Open CrashCourse/Exercises/index-external-styles.html and save it as index-inlines-styles.html.
2. Add inline styles to the table data cells containing the word “Giants”. The style should contain the following declarations:
 - color: darkred;
 - font-style: italic;
3. Add an inline style to the table data cell containing the word “Braves”. The style should contain the following declarations:
 - color: red;
 - font-style: italic;
4. Add an inline style to the table data cells containing the word “Yankees”. The style should contain the following declarations:
 - color: navy;
 - font-style: italic;
5. Add an inline style to the table data cells containing the word “Dodgers”. The style should contain the following declarations:
 - color: dodgerblue;
 - font-style: italic;
6. Open index-inline-styles.html in a browser. The last column should now look like this:

| Team |
|----------------|
| <i>Giants</i> |
| <i>Braves</i> |
| <i>Yankees</i> |
| <i>Yankees</i> |
| <i>Dodgers</i> |
| N/A |

Solution: CrashCourse/Solutions/index-inline-styles.html

```
-----Lines 1 through 19 Omitted-----  
20.   <tbody>  
21.     <tr class="steroids-era">  
22.       <td>Barry Bonds</td>  
23.       <td>762</td>  
24.       <td style="color: darkred; font-style: italic;">Giants</td>  
25.     </tr>  
26.     <tr>  
27.       <td>Hank Aaron</td>  
28.       <td>755</td>  
29.       <td style="color: red; font-style: italic;">Braves</td>  
30.     </tr>  
31.     <tr>  
32.       <td>Babe Ruth</td>  
33.       <td>714</td>  
34.       <td style="color: navy; font-style: italic;">Yankees</td>  
35.     </tr>  
36.     <tr class="steroids-era">  
37.       <td>Alex Rodriguez</td>  
38.       <td>696</td>  
39.       <td style="color: navy; font-style: italic;">Yankees</td>  
40.     </tr>  
41.     <tr>  
42.       <td>Albert Pujols</td>  
43.       <td>679</td>  
44.       <td style="color: dodgerblue; font-style: italic;">Dodgers</td>  
45.     </tr>  
46.   </tbody>  
-----Lines 47 through 59 Omitted-----
```

Evaluation
Copy

7.10. <div> and

The `<div>` and `` tags are used in conjunction with Cascading Style Sheets. By themselves, they do very little. In fact, the `` tag without CSS has no visual effect on its contents. The only visual effect of the `<div>` tag is to block off its contents, similar to putting a `
` tag before and after a section on the page.

Like all tags, the `<div>` and `` tags can take the `class`, `id`, and `style` attributes. It is through these attributes that styles are applied to the elements. Unlike `p` (paragraph) elements, `main` (main

content) elements, header (header content) elements, etc., div elements and span elements do not inherently represent anything. div elements are generic content containers for *flow* content and span elements are generic containers of *phrasing* content.

Flow and Phrasing Content

Phrasing content is content that *can fit* inside a sentence: images, emphasized text, links (usually), etc. Flow content is content that *cannot fit* inside a sentence: headings, tables, sections, etc.

For more information on content categories, see https://developer.mozilla.org/en-US/docs/Web/Guide/HTML/Content_categories.

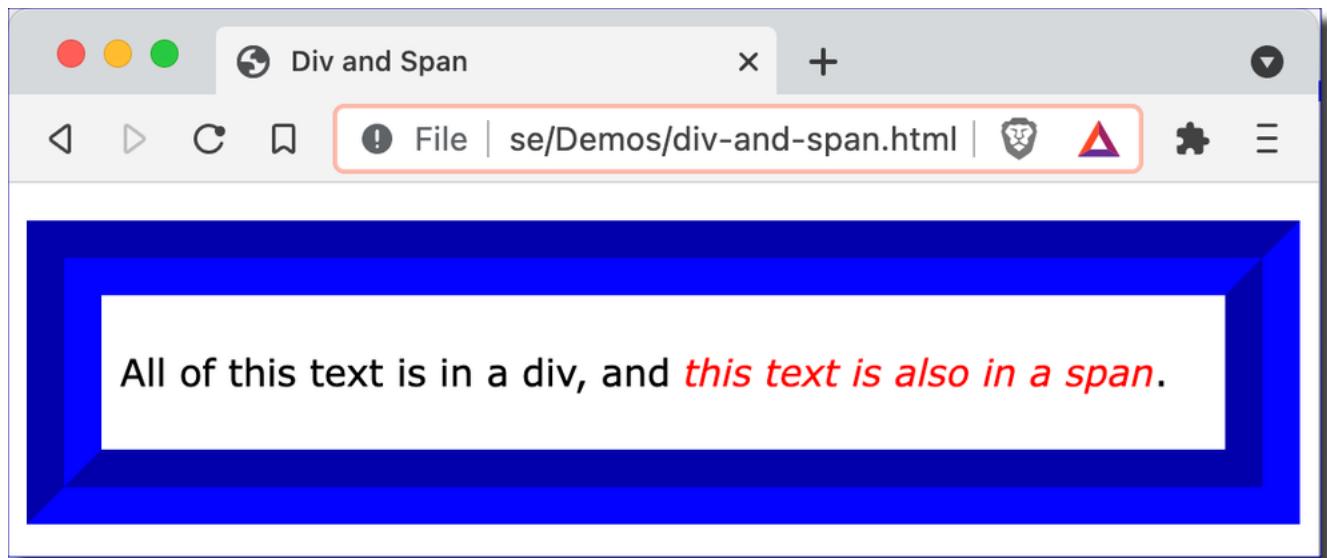
The following demo shows how you can apply styles to div and span elements:

Demo 7.7: CrashCourse/Demos/div-and-span.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link href="../normalize.css" rel="stylesheet">
7.  <style>
8.  div {
9.    border-color: blue;
10.   border-style: groove;
11.   border-width: 2em;
12.   font-family: Verdana;
13.   font-size: 1em;
14.   padding: .5em;
15. }
16.
17. span {
18.   color: red;
19.   font-style: italic;
20. }
21. </style>
22. <title>Div and Span</title>
23. </head>
24. <body class="webucator">
25. <div>
26.   <p>
27.     All of this text is in a div, and
28.     <span>this text is also in a span</span>.
29.   </p>
30. </div>
31. </body>
32. </html>
```

Evaluation
Copy

This page will render as follows:



Exercise 10: Styling div and span

 10 to 20 minutes

In this exercise, you will add `class` and `id` attributes to `<div>` and `` tags on an already existing HTML page. Open CrashCourse/Exercises/divs-and-spans.html and CrashCourse/Exercises/styles-divs-spans.css in your editor. You will need to modify the HTML page based on the code in the CSS page. You will not need to modify the CSS page. Your goal is to make the page render as follows:



There are no step-by-step instructions. Review the rules in the external stylesheet (`styles-divs-spans.css`) and apply classes and ids as appropriate.

Solution: CrashCourse/Solutions/divs-and-spans.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link href="../normalize.css" rel="stylesheet">
7.  <link href="styles-divs-spans.css" rel="stylesheet">
8.  <title>Divs and Spans</title>
9.  </head>
10. <body class="webucator">
11. <div id="top-div">
12.   <span class="left-span">1</span>
13.   <span class="mid-span">2</span>
14.   <span class="right-span">3</span>
15. </div>
16. <div id="mid-div">
17.   <span class="left-span">4</span>
18.   <span class="mid-span">5</span>
19.   <span class="right-span">6</span>
20. </div>
21. <div id="bottom-div">
22.   <span class="left-span">7</span>
23.   <span class="mid-span">8</span>
24.   <span class="right-span">9</span>
25. </div>
26. </body>
27. </html>
```

*

7.11. Media Types

Styles can be defined for different media. For example, you may want to style a page one way for viewing with a browser and a different way for viewing in print. Some possible media types are:

Media List

- all
- print
- screen
- speech

To define the media type for an entire external or embedded stylesheet, the `media` attribute is added to the `<link>` or `<style>` tag, and assigned the value of a media type. If the `media` attribute is not included, the media type defaults to `all`.

```
<link href="stylesheet.css" rel="stylesheet" media="screen">

<style media="all">
  /* rules */
</style>
```

It is also possible to target multiple media types within one stylesheet using `@media`.

```
@media screen {
  /* rules */
}

@media print {
  /* rules */
}
```

`@media` is a powerful CSS tool. As you will see later, it can be used to target not just the type of media but also aspects of the user's device: screen width, screen height, orientation, etc. This is done with media queries. Media queries allow us to craft pages that are responsive, presenting different layouts for desktop computers, tablet devices, and smartphones.

The viewport meta tag

You may have noticed that all of our files have a line of code in the head that looks like this:

```
<meta name="viewport" content="width=device-width, initial-scale=1">
```

This is called the *viewport meta tag* and it is used to help pages adjust correctly for all devices. You should use it on all your web pages. For detailed information, see https://developer.mozilla.org/en-US/docs/Web/HTML/Viewport_meta_tag.



7.12. Units of Measurement

CSS allows for the use of many different units when specifying property values such as font size, border size, margins, etc. However, standards have been established for what units to use for different media types. In these lessons, except where specifically stated, you will be designing for screen.

Note that units of measurement and sizing will be covered throughout these lessons. In this section, we provide a general overview of the different units of measurement.

❖ 7.12.1. Absolute vs. Relative Units

Absolute units have a basis in the physical world; however, their actual size on the screen depends on the resolution and size of the user's device. When designing for screen, it is standard to use *pixels* for absolute units.

Relative units are relative to the size of other things (e.g., window size, font size, container element size, etc.). When designing for screen, it is standard to use *ems*, *rems*, and *percentages* for relative units.

❖ 7.12.2. Pixels

Pixels are the only recommended absolute unit to be used when designing for screen. A common practice is to use pixels to set *root* font sizes for different screen and window sizes. Root font sizes are font sizes set on the `html` or `body` element. This allows for designs using mostly ems and remss to adjust between different screen and window sizes because ems and remss are relative to font size.

❖ 7.12.3. Ems and Rems

You should use ems and remss for almost everything when building responsive designs for screens. The exception to this rule is height and width, which are more often defined in pixels (for absolute values) and percentages or viewport units (for relative values). An *em* is the size of the font size for the current element or the parent element. For example, if the font-size of the `html` element is set to 14px, then for all elements within that `html` element, 1em is 14px.

Rems are similar to ems, except for one key difference. The 'r' in *rem* stands for 'root' because 1rem is always equal to the root font size (the font size set for the `html` element) regardless of what element it is in. This means 1rem is consistent throughout the page, while 1em is not. Both ems and remss can be used to accomplish the same things.

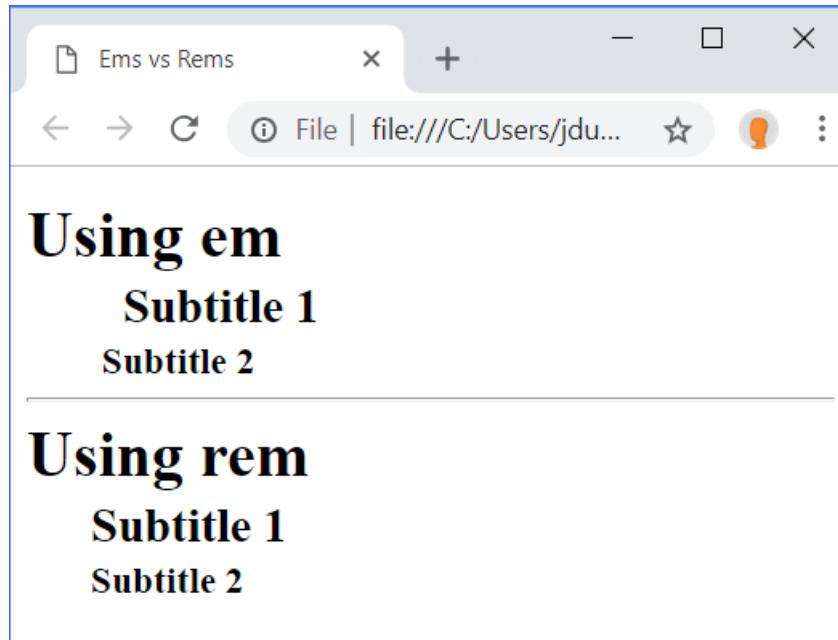
The code below illustrates the difference between ems and remss:

Demo 7.8: CrashCourse/Demos/ems-vs-rems.html

```
1.  <!DOCTYPE HTML>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link href="../normalize.css" rel="stylesheet">
7.  <style>
8.      /* Tighten vertical spacing of headings. */
9.      h1,
10.     h2,
11.     h3 {
12.         margin-bottom: .2rem;
13.         margin-top: .2rem;
14.     }
15. </style>
16. <title>Ems vs Rems</title>
17. </head>
18. <body class="webucator">
19.     <h1>Using em</h1>
20.     <h2 style="margin-left: 2em;">Subtitle 1</h2>
21.     <h3 style="margin-left: 2em;">Subtitle 2</h3>
22.
23.     <hr>
24.
25.     <h1>Using rem</h1>
26.     <h2 style="margin-left: 2rem;">Subtitle 1</h2>
27.     <h3 style="margin-left: 2rem;">Subtitle 2</h3>
28. </body>
29. </html>
```

Evaluation
Copy

The code above will render the following:



Notice that “Subtitle 1” and “Subtitle 2” do not line up in the **Using em** section, but do line up in the **Using rem** section. This is because the ems are relative to the font sizes of their h2 and h3 elements, while the rems are not:

- 2em = twice the size of the *inherited* font.
- 2rem = twice the size of the *base* font.

❖ 7.12.4. Percentages

Percentages are most often used to create flexible layouts that change to fit the size of the browser window. When specifying a value such as `width` or `height` in percentages, the percentage is relative to the size of the containing element. For `font-size`, percentages work the same as ems. 100% is equal to the inherited font size, so 100% is essentially 1em when specifying font size. It is most common to use percentages to specify values like `width` and `height` to create “fluid” boxes that grow and shrink to fit within the browser window.

❖ 7.12.5. Other Units

Inches (`in`), centimeters (`cm`), millimeters (`mm`), points (`pt`), and picas (`pc`) are all absolute units that are most often used when designing for print.

You might also run into viewport units, which are relative units based on the size of the viewport (the browser window). `vw` and `vh` specify sizes relative to the user's viewport width and height, respectively.

1. `vw` is 1/100th of the viewport's width.
2. `vh` is 1/100th of the viewport's height.
3. `vmax` specifies size relative to whichever dimension is larger: width or height.
4. `vmin` specifies size relative to whichever dimension is smaller: width or height.

Viewport units are used for designing for screen, but they are not as commonly used as other screen units, in part because the specification is not clear on how they should behave on mobile²⁶. There are newer units called *dynamic viewport units* coming, but major browsers do not yet support them²⁷.

If you would like to play with the different CSS units to see how they compare on a screen, open `CrashCourse/Demos/units-of-measurement.html` (shown below) in your browser:

26. <https://www.bram.us/2021/07/08/the-large-small-and-dynamic-viewports/>
27. <https://caniuse.com/?search=viewport%20units>

Units of Measurement

Unit Size: Font Size:

Relative Units

| Unit | Abbr | Length | To Change |
|---|------|--------|---|
| Width of capital M | em | M | Change font size. |
| Height of lowercase x | ex | x | Change font size. |
| Width of the number 0 | ch | 0 | Change font size. |
| Root em | rem | | n/a |
| 1/100 th of Width of Viewport | vw | | Change width of browser window. |
| 1/100 th of Height of Viewport | vh | | Change height of browser window. |
| 1/100 th of Viewport's Smaller Dimension | vmin | | Change height or width of browser window. |
| 1/100 th of Viewport's Larger Dimension | vmax | | Change height or width of browser window. |

Absolute Units

| Unit | Abbr | Length |
|---------------------|------|--------|
| Pixels | px | 1 |
| Quarter millimeters | q | 1 |
| Millimeters | mm | 1 |
| Centimeters | cm | 10 |
| Picas | pc | 1 |
| Points | pt | 1 |
| Inches | in | 100 |

Percentage

50

For even more detailed information on CSS values and units see https://developer.mozilla.org/en-US/docs/Learn/CSS/Introduction_to_CSS/Values_and_units.



7.13. Inheritance

By default, all CSS properties are either **inherited** or **non-inherited** properties. This difference determines what happens when a property for an element goes unspecified.

If an inherited property for an element goes unspecified, then that element will inherit the value from its parent element. A common inherited property is `font-size`:

Demo 7.9: CrashCourse/Demos/inherited.html

```
1.  <!DOCTYPE HTML>
2.  <html>
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link href="../normalize.css" rel="stylesheet">
7.  <style>
8.    p {
9.      font-size: 20px;
10.   }
11. </style>
12. <title>Inherited Properties</title>
13. </head>
14. <body class="webucator">
15.   <p>This is a paragraph element with a
16.     <strong>strong element</strong> within it.</p>
17. </body>
18. </html>
```

The above code will render the following:

This is a paragraph element with a **strong** element within it.

Notice that the **strong** element has the same font size as the **p** element, even though **font-size** was not specified for it.

If a non-inherited property for an element goes unspecified, then that element will get the initial (default) value of that property. A common non-inherited property is **border**:

Demo 7.10: CrashCourse/Demos/non-inherited.html

```
1.  <!DOCTYPE HTML>
2.  <html>
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link href="../../normalize.css" rel="stylesheet">
7.  <style>
8.  p {
9.    border: 0.2rem solid black;
10. }
11. </style>
12. <title>Non-Inherited Properties</title>
13. </head>
14. <body class="webucator">
15.   <p>This is a paragraph element with a
16.     <strong>strong element</strong> within it.</p>
17. </body>
18. </html>
```

The above code will render the following:

This is a paragraph element with a **strong** element within it.

Notice that the **strong** element does not also have its own border. This is because the initial value for **border** is **none** and **border** is **not** an inherited property.

❖ 7.13.1. The inherit Value

You can force a property to inherit the value of its parent by setting its value to `inherit`.

The `inherit` property is most often used to override other rules, as illustrated in the following demo:

Demo 7.11: CrashCourse/Demos/inherit-styles.css

```
1.  h2 {  
2.    color: blue;  
3.  }  
4.  
5.  article h2 {  
6.    color: inherit;  
7.  }  
8.  
9.  #article-red {  
10.   color: red;  
11. }  
12.  
13. #article-green {  
14.   color: green;  
15. }  
16.  
17. #article-purple {  
18.   color: purple;  
19. }
```

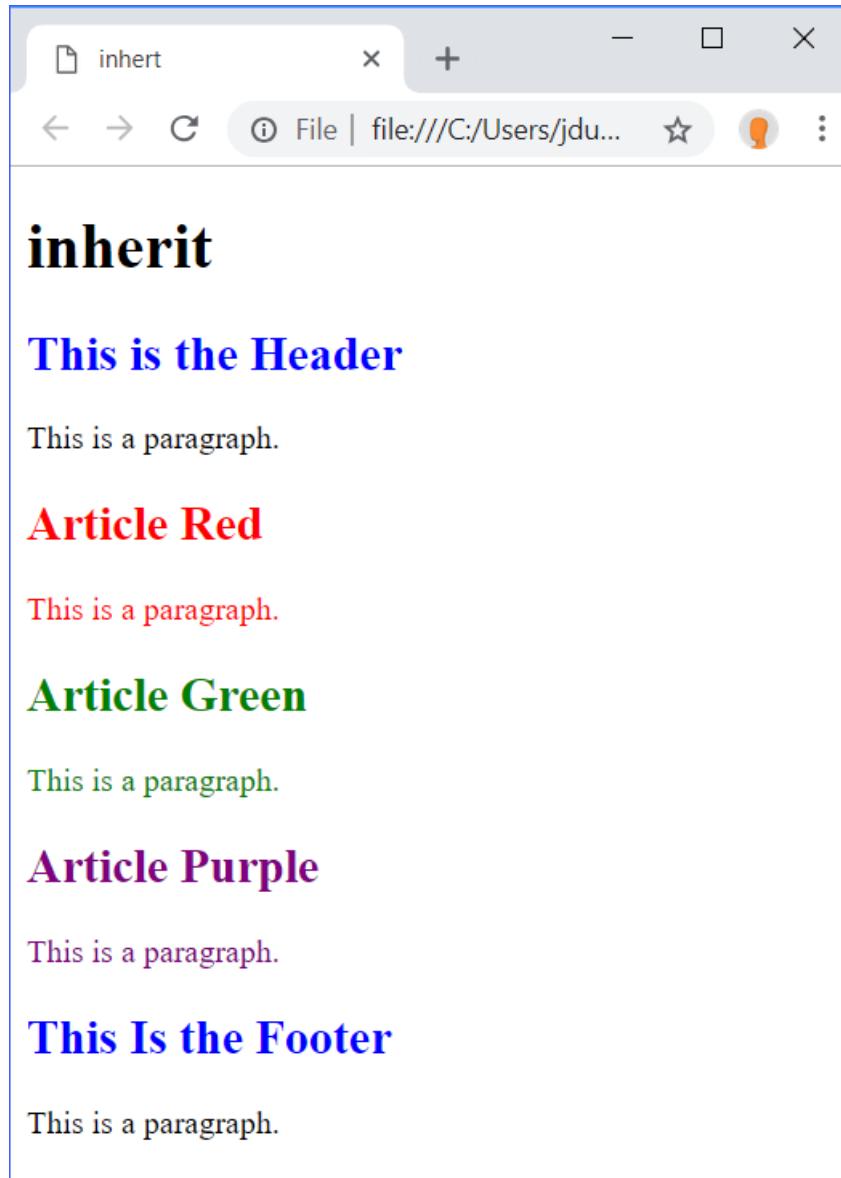
Evaluation
Copy

Demo 7.12: CrashCourse/Demos/inherit.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1>inherit</h1>  
12.   <header>  
13.     <h2>This is the Header</h2>  
14.     <p>This is a paragraph.</p>  
15.   </header>  
16.   <article id="article-red">  
17.     <h2>Article Red</h2>  
18.     <p>This is a paragraph.</p>  
19.   </article>  
20.   <article id="article-green">  
21.     <h2>Article Green</h2>  
22.     <p>This is a paragraph.</p>  
23.   </article>  
24.   <article id="article-purple">  
25.     <h2>Article Purple</h2>  
26.     <p>This is a paragraph.</p>  
27.   </article>  
28.   <footer>  
29.     <h2>This Is the Footer</h2>  
30.     <p>This is a paragraph.</p>  
31.   </footer>  
32. </body>  
33. </html>
```

The above code will render the following:²⁸

28. If you are reading this in black and white, be sure to open the page in your browser.



Notice that this rule says that all h2 elements should be blue:

```
h2 {  
  color: blue;  
}
```

This rule would normally trump inheritance. In other words, by default the h2 elements would inherit the color of their parent element, but the rule above overrides that, specifying that all h2 elements should be blue.

But in the result, the h2 elements in the article elements are **not** blue. Why?

Because this more specific rule says that h2 elements within article elements should inherit the color property from their parent elements:

```
article h2 {  
    color: inherit;  
}
```

Evaluation
Copy

Conclusion

Cascading Style Sheets provide a far better way of formatting HTML pages than the traditional use of HTML tags. In this lesson, you have developed a foundation for creating and applying CSS rules.

LESSON 8

CSS Fonts

Topics Covered

- font-family
- @font-face.
- font-size
- font-style
- font-variant
- font-weight
- line-height
- Shorthand properties.
- font

Evaluation
Copy

Introduction

In this lesson, you will learn to use CSS to modify font properties. You will also learn to work with CSS shorthand properties.



8.1. font-family

The `font-family` property is used in CSS to specify the font applied to an element. You can specify by font name or font category.

❖ 8.1.1. Specifying by Font Name

When you specify a font by font name, the browser will look for the named font on the end user's computer. If it finds it, the text will be displayed in that font. For example, the following rule would make the font of all `<p>` tags Arial:

```
p {  
    font-family: Arial;  
}
```

If the Arial font were not found on the end user's computer, the browser would display a default font. If you are concerned that the font name you want to use might not be found on a user's computer, you can provide a list of options.

```
p {  
    font-family: Arial, Helvetica;  
}
```

In this case, the browser will first look for Arial. If it doesn't find Arial, it will then look for Helvetica.

❖ 8.1.2. Specifying Font by Category

When you specify a font by category, the browser will use the font the user's computer specifies for that category. For example, for monospace, the computer might specify Courier. Some common font family categories are listed below:

- **cursive**
- **fantasy**
- **monospace**
- **sans-serif**
- **serif**

To be extra safe, designers often specify a couple specific options followed by a font family category, like so:

```
p {  
    font-family: Arial, Helvetica, sans-serif;  
}
```

This way, if neither Arial nor Helvetica is found, the browser at least knows to use some sans-serif font.

The following code samples illustrate how `font-family` works:

Demo 8.1: Fonts/Demos/font-family-styles.css

```
1. #cursive-div {  
2.   font-family: 'Cool Linked Font', cursive;  
3. }  
4.  
5. #fantasy-div {  
6.   font-family: 'Cool Linked Font', fantasy;  
7. }  
8.  
9. #monospace-div {  
10.   font-family: 'Courier New', monospace;  
11. }  
12.  
13. #sans-serif-div {  
14.   font-family: Tahoma, Verdana, Arial, sans-serif;  
15. }  
16.  
17. #serif-div {  
18.   font-family: Times, 'Times New Roman', Georgia, serif;  
19. }
```

Evaluation
Copy

Notice that `#cursive-div` and `#fantasy-div` both have a 'Cool Linked Font' listed before their generic family names. Cursive and fantasy fonts are not as popular or as widely supported as the other three, so it is common to load your own fonts for these two font families.

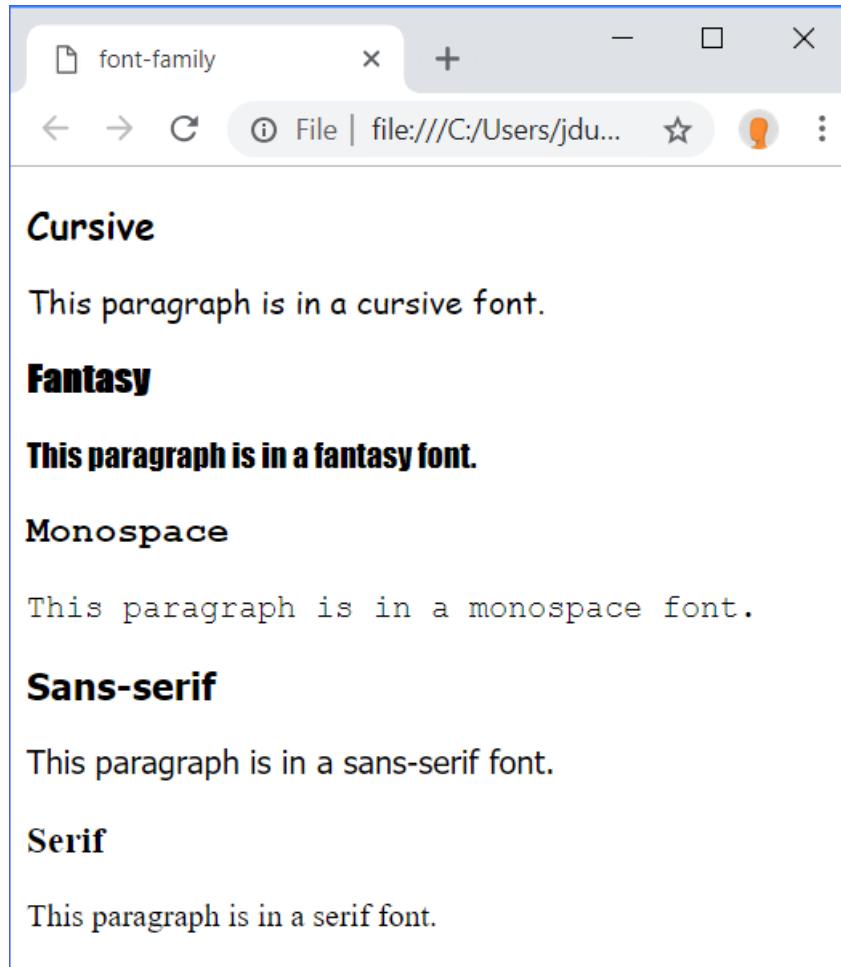
Also notice that fonts that have multi-word names (e.g., Times New Roman) should be contained in either single or double quotes.

Here is an HTML page that uses the stylesheet shown above:

Demo 8.2: Fonts/Demos/font-family.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <div id="cursive-div">  
12.     <h3>Cursive</h3>  
13.     <p>This paragraph is in a cursive font.</p>  
14.   </div>  
15.   <div id="fantasy-div">  
16.     <h3>Fantasy</h3>  
17.     <p>This paragraph is in a fantasy font.</p>  
18.   </div>  
19.   <div id="monospace-div">  
20.     <h3>Monospace</h3>  
21.     <p>This paragraph is in a monospace font.</p>  
22.   </div>  
23.   <div id="sans-serif-div">  
24.     <h3>Sans-serif</h3>  
25.     <p>This paragraph is in a sans-serif font.</p>  
26.   </div>  
27.   <div id="serif-div">  
28.     <h3>Serif</h3>  
29.     <p>This paragraph is in a serif font.</p>  
30.   </div>  
31. </body>  
32. </html>
```

The code above will render as follows:



The web-safe fonts are those fonts that are most commonly installed on computers and are therefore safe to use in your CSS. You can see the full list of web-safe fonts on [cssfontstack.com](https://www.cssfontstack.com)²⁹.



8.2. @font-face

The CSS `@font-face` rule enables the loading of a font file, and thus offers us the ability to use any font, not just those our users happen to have loaded on their computer or device. The `@font-face` rule is defined in the W3C's CSS Fonts Module Level 3³⁰ specification. As the W3C specification states:

29. <https://www.cssfontstack.com/>
30. <https://www.w3.org/TR/css-fonts-3/>

The `@font-face` rule allows for linking to fonts that are automatically fetched and activated when needed. This allows authors to select a font that closely matches the design goals for a given page rather than limiting the font choice to a set of fonts available on a given platform. A set of font descriptors define the location of a font resource, either locally or externally, along with the style characteristics of an individual face. Multiple `@font-face` rules can be used to construct font families with a variety of faces. Using CSS font matching rules, a user agent can selectively load only those faces that are needed for a given piece of text.

In the CSS, you define your own `font-family` and associate it with a font file:³¹

```
@font-face {  
    font-family: Gentium;  
    src: url('Gentium.ttf');  
}
```

A subsequent CSS rule could style a given element with the newly defined `font-family`:

```
div.newsitem {  
    font-family: Gentium;  
}
```

Browsers will download the specified font file and will use it to render the designated content.

Different browsers support different font file formats. To address these differences, the specification for the `@font-face` rule allows for a series of font files, with format hints to aid browsers in selecting the appropriate file for the font:

```
@font-face {  
    font-family: bodytext;  
    src: url(ideal-sans-serif.woff) format("woff"),  
        url(basic-sans-serif.ttf) format("opentype");  
}
```

³¹. We will cover how to get font files soon.

Here's a list of the formats supported by the W3C specification:³²

1. Embedded OpenType

- **Format string:** embedded-opentype
- **Extension(s):** .eot
- Only supported in Internet Explorer.

2. OpenType

- **Format string:** opentype
- **Extension(s):** .ttf, .otf
- Well supported, but in Internet Explorer it only works with fonts set to installable.

3. SVG Font

- **Format string:** svg
- **Extension(s):** .svg, .svgz
- Not well supported.

4. TrueType

- **Format string:** truetype
- **Extension(s):** .ttf
- Well supported, but in Internet Explorer it only works with fonts set to installable.

5. WOFF (Web Open Font Format)

- **Format string:** woff
- **Extension(s):** .woff
- Well supported.

6. WOFF 2.0

- **Format string:** woff2
- **Extension(s):** .woff2
- Supported well in most recent browsers, but not supported in Internet Explorer or older browsers.

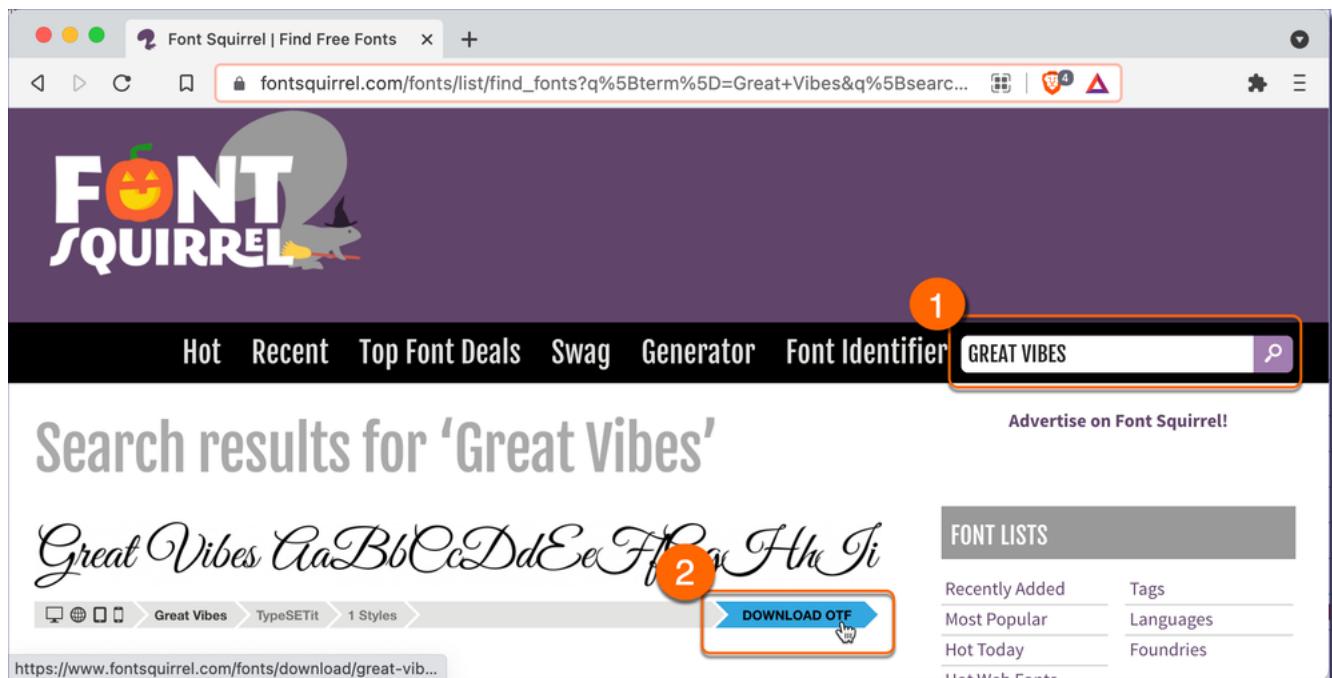
^{32.} <https://www.w3.org/TR/2018/REC-css-fonts-3-20180920/#fontformats>

In the @font-face rule, you can specify additional properties, such as font-style and font-weight, which we will cover soon.

❖ 8.2.1. Getting Fonts

Let's look at a typical example, in which you will download the font "Great Vibes" from Font Squirrel³³, a popular resource for free fonts and then convert it into several different file font formats:

1. Search <https://www.fontsquirrel.com> for "Great Vibes":

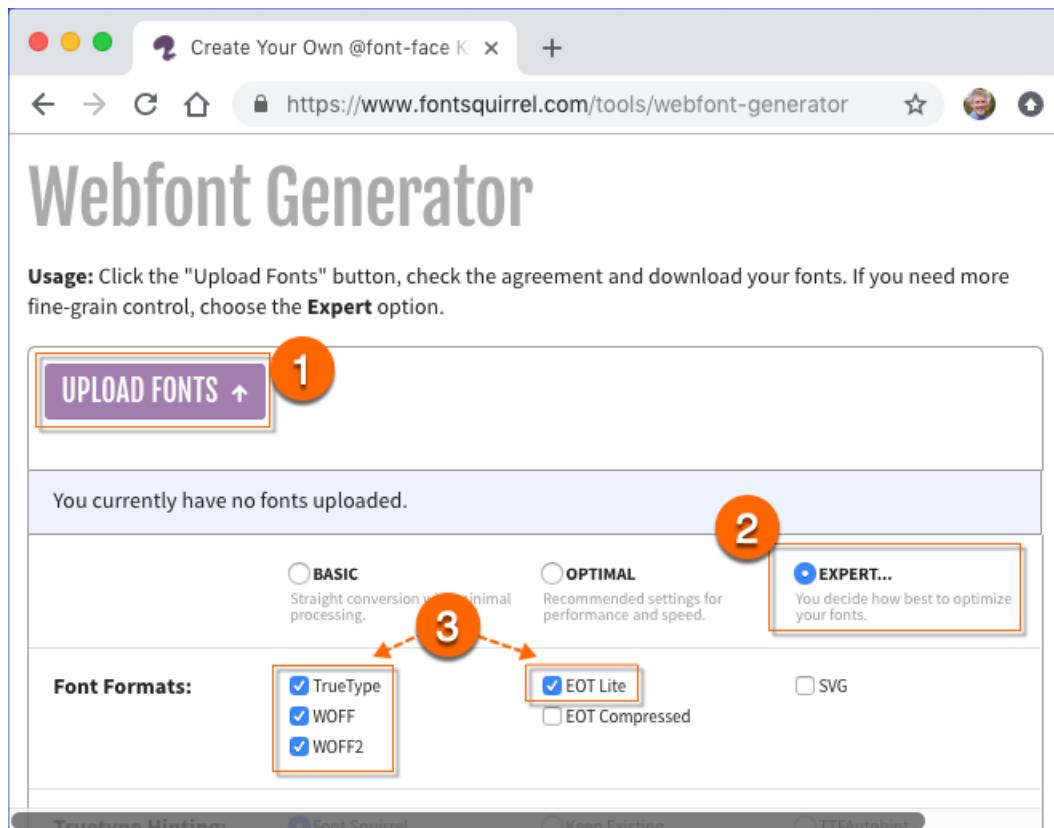


Click the **DOWNLOAD OTF** button to download the zip file containing the font. You can save it wherever you like.

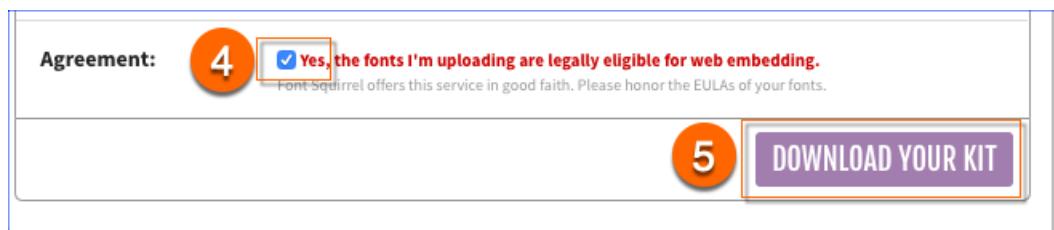
2. Unzip the file. You will see a GreatVibes-Regular.otf file.
3. To convert the GreatVibes-Regular.otf to other file types, use the Font Squirrel Webfont Generator.³⁴
4. Upload the OpenType file you just downloaded and choose four font formats to convert it to. Select the "Expert" option as the other options do not allow for the specific selection of font formats:

33. <https://www.fontsquirrel.com/>

34. <https://www.fontsquirrel.com/tools/webfont-generator>



5. At the bottom of the generator, check the agreement box and click the **DOWNLOAD YOUR KIT** button:



6. You can save it wherever you like.
6. Unzip the file. Among its contents, you will see:

 greatvibes-regular-demo.html – a demo HTML file using the new font.

 stylesheet.css – A stylesheet demonstrating how to create the @font-face rule:

```
@font-face {  
    font-family: 'great_vibesregular';  
    src: url('greatvibes-regular-webfont.eot');  
    src: url('greatvibes-regular-webfont.eot?#iefix') format('embedded-  
opentype'),  
        url('greatvibes-regular-webfont.woff2') format('woff2'),  
        url('greatvibes-regular-webfont.woff') format('woff');  
    font-weight: normal;  
    font-style: normal;  
}
```

- Three font files:

-  greatvibes-regular-webfont.eot
-  greatvibes-regular-webfont.woff
-  greatvibes-regular-webfont.woff2

7. Open greatvibes-regular-demo.html to see the demo, which illustrates the use of “Great Vibes” in different sizes, shows a sample page that uses only the “Great Vibes” font, and provides charts showing special characters and glyphs.

Internet Explorer Bug

In the generated stylesheet, notice the ?#iefix appended to the .eot file. This tricks versions of Internet Explorer to get around a known bug for not loading multiple versions of the font file.

We made a few edits to the generated stylesheet and attached it to a simple HTML page as you can see in the samples below:

Demo 8.3: Fonts/Demos/font-face-styles.css

```
1.  @font-face {
2.    font-family: 'GreatVibes';
3.    src: url('fonts/greatvibes-regular-webfont.eot');
4.    src: url('fonts/greatvibes-regular-webfont.eot?#iefix')
5.         format('embedded-opentype'),
6.        url('fonts/greatvibes-regular-webfont.woff2')
7.         format('woff2'),
8.        url('fonts/greatvibes-regular-webfont.woff')
9.         format('woff'),
10.       url('fonts/greatvibes-regular-webfont.ttf')
11.      format('truetype');
12.     font-weight: normal;
13.     font-style: normal;
14.   }
15.
16. p {
17.   font-family: GreatVibes;
18. }
```



We changed the font name from what the generated stylesheet suggested, and we adjusted the paths for the urls. In the Fonts/Demos folder, we moved all of our “Great Vibes” font files into a folder called **fonts**, and we deleted the unnecessary generated files (e.g., the demo file, the original stylesheet, etc.).

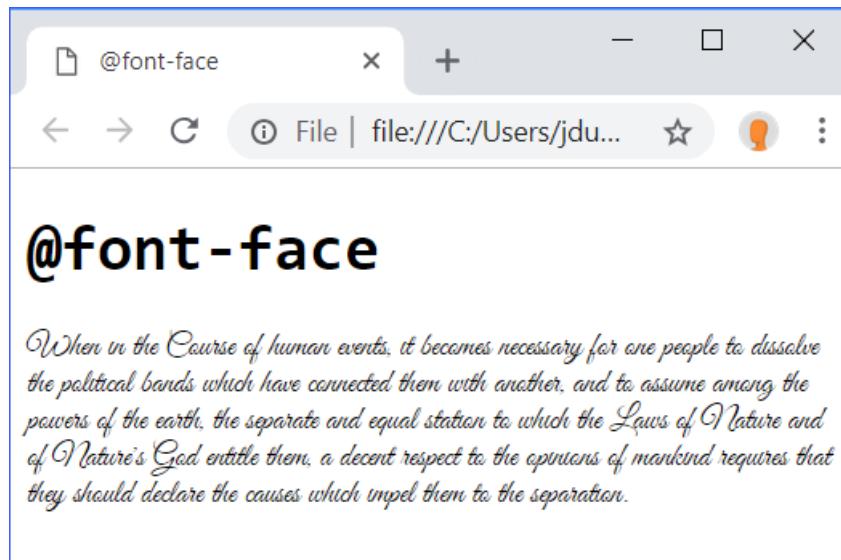
Finally, after the `@font-face` rule, we used the “Great Vibes” font to style the first paragraph of the U.S. Declaration of Independence.

Here's the HTML:

Demo 8.4: Fonts/Demos/font-face.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1><code>@font-face</code></h1>  
12.   <p>When in the Course of human events, it becomes necessary  
13.       for one people to dissolve the political bands which have  
14.       connected them with another, and to assume among the powers  
15.       of the earth, the separate and equal station to which the  
16.       Laws of Nature and of Nature's God entitle them, a decent  
17.       respect to the opinions of mankind requires that they should  
18.       declare the causes which impel them to the separation.</p>  
19. </body>  
20. </html>
```

And here is the resulting page:



*

8.3. font-size

font-size is an unexpectedly complicated CSS property. It is difficult to quickly grasp the different font-size units, how they relate to each other, and how they change depending on the font family. It will require some practice and experimentation to get used to.

❖ 8.3.1. Relative font-size Terms

In addition to all the units of measurement we discussed in the Crash Course lesson (see page 142), font size can be defined using the following terms:

- **xx-large**
- **x-large**
- **large**
- **medium**
- **small**
- **x-small**
- **xx-small**
- **smaller**
- **larger**

Evaluation
Copy

The terms **xx-small** to **xx-large** are absolute-size keywords relative to the user's default font size (**medium**). The terms **smaller** and **larger** are relative-size keywords, meaning that they change the font size of an element relative to its parent element's font size. The following examples illustrate these terms:

Demo 8.5: Fonts/Demos/font-size-styles.css

```
1. .biggest {
2.   font-size: xx-large;
3. }
4.
5. .second-biggest {
6.   font-size: x-large;
7. }
8.
9. .third-biggest {
10.   font-size: large;
11. }
12.
13. .medium {
14.   font-size: medium;
15. }
16.
17. .third-smallest {
18.   font-size: small;
19. }
20.
21. .second-smallest {
22.   font-size: x-small;
23. }
24.
25. .smallest {
26.   font-size: xx-small;
27. }
28.
29. .larger {
30.   font-size: larger;
31. }
32.
33. .smaller {
34.   font-size: smaller;
35. }
```

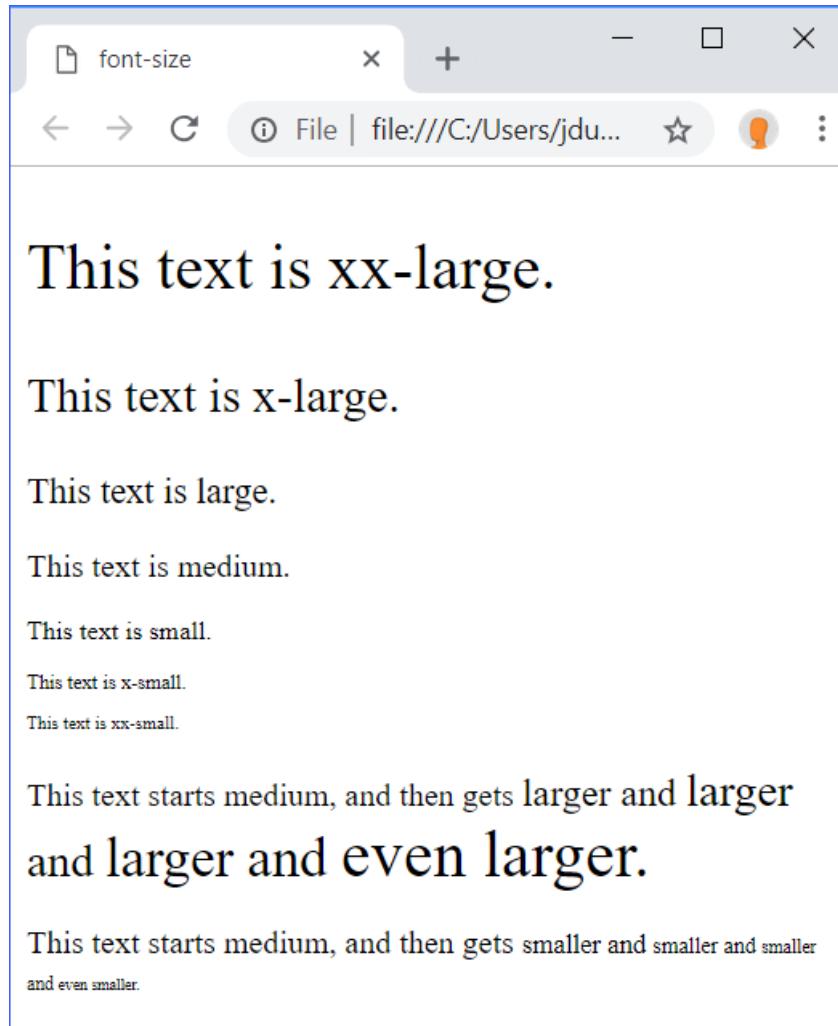
Evaluation
Copy

Demo 8.6: Fonts/Demos/font-size.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <p class="biggest">This text is xx-large.</p>  
12.   <p class="second-biggest">This text is x-large.</p>  
13.   <p class="third-biggest">This text is large.</p>  
14.   <p class="medium">This text is medium.</p>  
15.   <p class="third-smallest">This text is small.</p>  
16.   <p class="second-smallest">This text is x-small.</p>  
17.   <p class="smallest">This text is xx-small.</p>  
18.   <div id="compare-div" class="medium">  
19.     <p>This text starts medium, and then gets  
20.       <span class="larger">larger and  
21.         <span class="larger">larger and  
22.           <span class="larger">larger and  
23.             <span class="larger">even larger.  
24.           </span>  
25.         </span>  
26.       </span>  
27.     </span>  
28.   </p>  
29.   <p>This text starts medium, and then gets  
30.     <span class="smaller">smaller and  
31.       <span class="smaller">smaller and  
32.         <span class="smaller">smaller and  
33.           <span class="smaller">even smaller.  
34.         </span>  
35.       </span>  
36.     </span>  
37.   </span>  
38.   </p>  
39. </div>  
40. </body>  
41. </html>
```

Evaluation
Copy

The code above will output the following:



Visualizing Ems and Rems

For a visual representation of fonts using `ems` and `rems`, open `CrashCourse/Demos/units-of-measurement.html` in your browser.

❖ 8.3.2. Best Practices

Most experts agree that font size should be defined in relative units (e.g., `em`, `rem`, or `%`) or in terms (e.g., `large`, `small`, etc.). This is because absolute font sizes can make pages inaccessible to people who have difficulty seeing. In most browsers, a user can change both the “zoom” of the page and, separately, the default font size. While “zooming” will increase the size of all elements (font included)

on the page, changing the default browser font size won't have any effect on fonts whose size in CSS is specified using absolute, rather than relative, units.



8.4. font-style

Currently, the only use for `font-style` is to italicize (and unitalicize) text. The values are listed below:

- `normal`
- `italic`
- `oblique`

However, `italic` and `oblique` are displayed in the same way. Since `italic` has better support, you should use it. For more on `font-style`, see <https://developer.mozilla.org/en-US/docs/Web/CSS/font-style>.



8.5. font-variant

The most common and well-supported use of `font-variant` is to turn lowercase letters into small caps. The values are listed below:

- `normal`
- `small-caps`

The screenshot below shows an `h1` tag with `small-caps`:³⁵

³⁵. The file used for this screenshot is `Fonts/Demos/font-variant.html`.



`font-variant` is actually a shorthand property (more on shorthand properties soon) for several longhand properties, but those are rarely used and poorly supported, so you shouldn't worry about them. For more details, see <https://developer.mozilla.org/en-US/docs/Web/CSS/font-variant>.

8.6. font-weight

Evaluation
Copy

The weight of a font determines how thick (or bold) it is. Possible values are:

- Any number between 1 and 1000
- `bold`
- `bolder`
- `lighter`
- `normal`

The numeric values are used for fonts that can have many different degrees of boldness. Most fonts, however, are either `bold` or `normal` (not bold). `bold` is the same as `700` and `normal` is the same as `400`. `bolder` and `lighter` work similarly to `larger` and `smaller` for `font-size`.

Here is a stylesheet with rules setting `font-weight` for elements on the page:

Demo 8.7: Fonts/Demos/font-weight-styles.css

```
1.  html {
2.      font-family:'Segoe UI', 'Open Sans',
3.      'Helvetica Neue', sans-serif;
4.  }
5.  #div1 {
6.      font-weight: normal;
7.  }
8.  #div2 {
9.      font-weight: bold;
10. }
11. #div3 {
12.     font-weight: 400;
13. }
14. #div4 {
15.     font-weight: 1000;
16. }
17. .bolder {
18.     font-weight: bolder;
19. }
20. .lighter {
21.     font-weight: lighter;
22. }
23. #li1 {
24.     font-weight: 100;
25. }
26. #li2 {
27.     font-weight: 400;
28. }
29. #li3 {
30.     font-weight: 600;
31. }
32. #li4 {
33.     font-weight: 700;
34. }
35. #li5 {
36.     font-weight: 900;
37. }
```

Evaluation
Copy

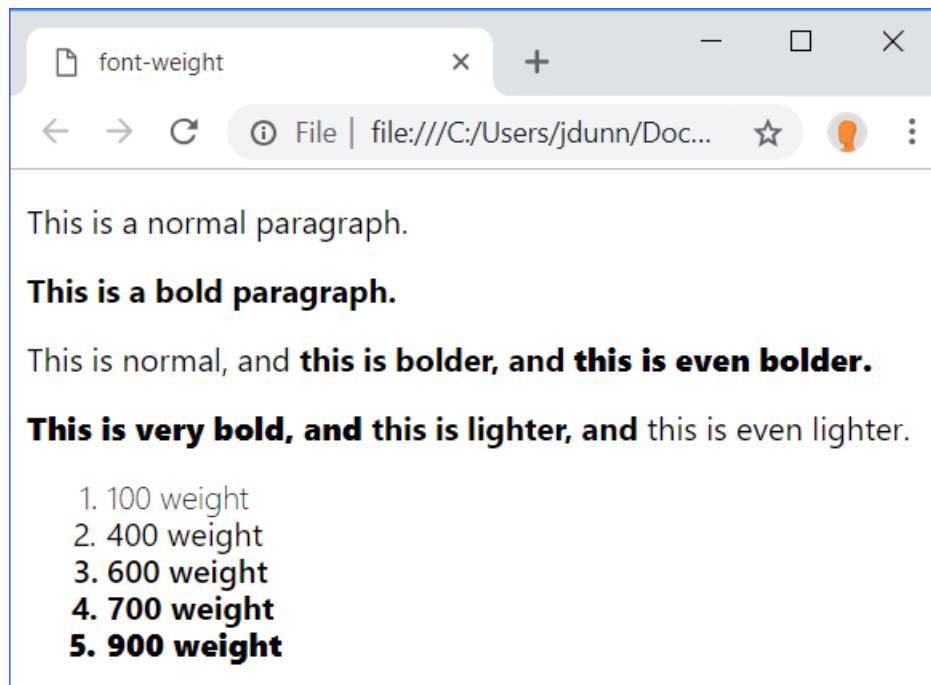
We used the Segoe UI font because it has precise control over its weight. If we were to use a font that didn't have this control, like Times, then each element would only render either **bold** or **normal**.

And here is an HTML page that uses this stylesheet:

Demo 8.8: Fonts/Demos/font-weight.html

```
-----Lines 1 through 9 Omitted-----
10. <body class="webucator">
11.   <div id="div1">
12.     <p>This is a normal paragraph.</p>
13.   </div>
14.   <div id="div2">
15.     <p>This is a bold paragraph.</p>
16.   </div>
17.   <div id="div3">
18.     <p>This is normal, and
19.       <span class="bolder">this is bolder, and
20.         <span class="bolder">this is even bolder.
21.           </span>
22.         </span>
23.       </p>
24.     </div>
25.     <div id="div4">
26.       <p>This is very bold, and
27.         <span class="lighter">this is lighter, and
28.           <span class="lighter">this is even lighter.
29.             </span>
30.           </span>
31.         </p>
32.       </div>
33.       <ol>
34.         <li id="li1">100 weight</li>
35.         <li id="li2">400 weight</li>
36.         <li id="li3">600 weight</li>
37.         <li id="li4">700 weight</li>
38.         <li id="li5">900 weight</li>
39.       </ol>
40.     </body>
41.   </html>
```

The code above will render the following:



font-weight Values

In early versions of `font-weight`, only intervals of 100 (100 to 900) were accepted, so if you use a more exact number value, make sure both the font you're using and your target browsers support that value. For more on `font-weight`, see <https://developer.mozilla.org/en-US/docs/Web/CSS/font-weight>.



8.7. line-height

`line-height` determines the amount of vertical space used for lines, most commonly in text.

Although there are several options for `line-height` values, the best option is to use a unit-less number. This number is relative to the `font-size` of the text. For example, if you set `line-height` to 1, there will be no space between the text on a line and the text on lines before and after that line.

The default `line-height` value is approximately 1.2. You can set that specifically using:

```
line-height: 1.2;
```

Or you can set it using:

```
line-height: normal;
```

The latter will set the `line-height` to the exact default value, which is dependent on the browser and the font.

To add more space between lines, set `line-height` to a value higher than 1.2 and to make lines tighter, set it to a value less than 1.2.

Other Values of line-height

While `line-height` can also take a length with units (e.g., `em` or `px`), we recommend you stick with a unit-less number.

The following samples shows some different line heights:

Demo 8.9: Fonts/Demos/line-height-styles.css

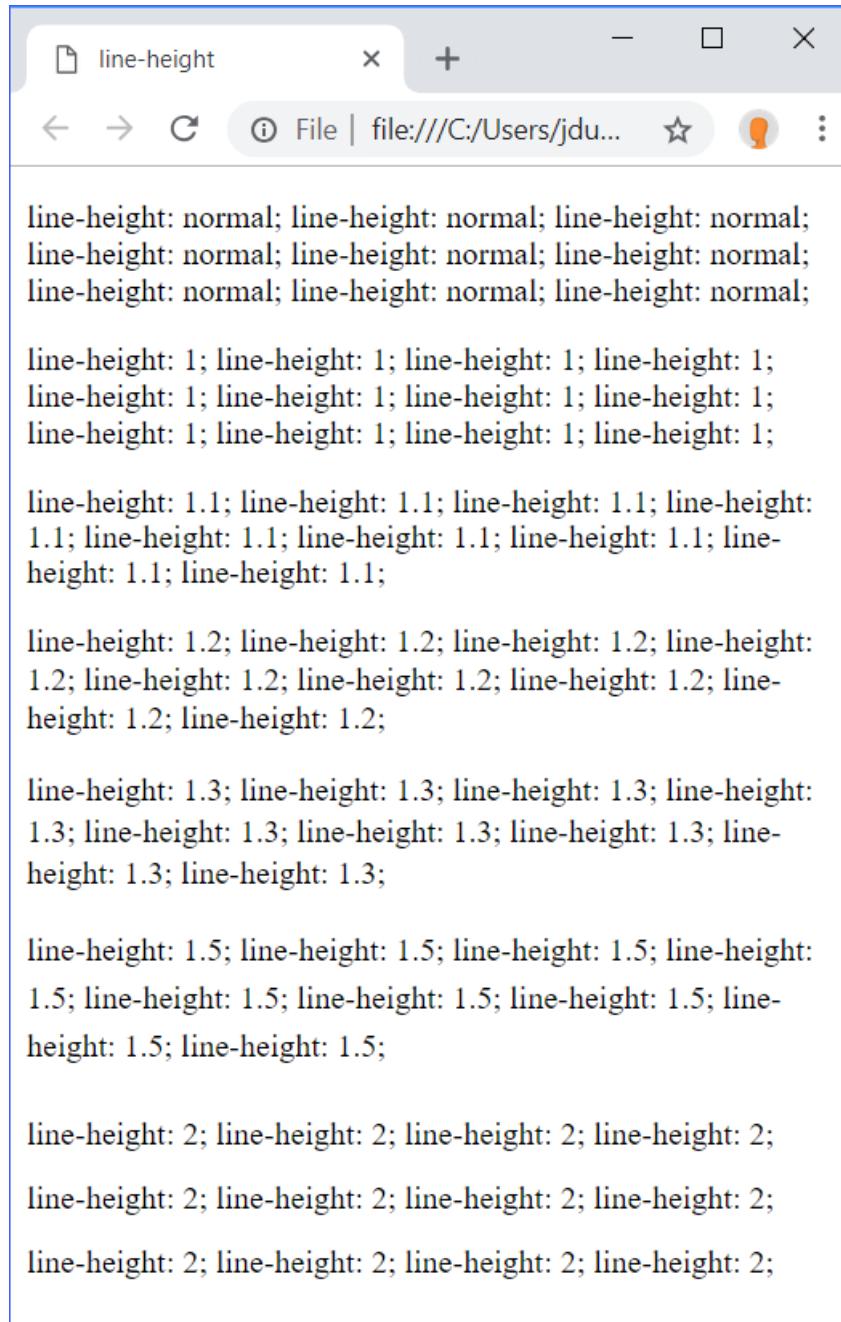
```
1.  html {
2.    font-size: 16px;
3.  }
4.
5.  #normal {
6.    line-height: normal;
7.  }
8.
9.  #p1 {
10.   line-height: 1;
11. }
12.
13. #p2 {
14.   line-height: 1.1;
15. }
16.
17. #p3 {
18.   line-height: 1.2;
19. }
20.
21. #p4 {
22.   line-height: 1.3;
23. }
24.
25. #p5 {
26.   line-height: 1.5;
27. }
28.
29. #p6 {
30.   line-height: 2;
31. }
```

Evaluation
Copy

Demo 8.10: Fonts/Demos/line-height.html

```
-----Lines 1 through 9 Omitted-----
10. <body class="webucator">
11.   <p id="normal">
12.     line-height: normal; line-height: normal; line-height: normal;
13.     line-height: normal; line-height: normal; line-height: normal;
14.     line-height: normal; line-height: normal; line-height: normal;
15.   </p>
16.   <p id="p1">
17.     line-height: 1; line-height: 1; line-height: 1; line-height: 1;
18.     line-height: 1; line-height: 1; line-height: 1; line-height: 1;
19.     line-height: 1; line-height: 1; line-height: 1; line-height: 1;
20.   </p>
21.   <p id="p2">
22.     line-height: 1.1; line-height: 1.1; line-height: 1.1;
23.     line-height: 1.1; line-height: 1.1; line-height: 1.1;
24.     line-height: 1.1; line-height: 1.1; line-height: 1.1;
25.   </p>
26.   <p id="p3">
27.     line-height: 1.2; line-height: 1.2; line-height: 1.2;
28.     line-height: 1.2; line-height: 1.2; line-height: 1.2;
29.     line-height: 1.2; line-height: 1.2; line-height: 1.2;
30.   </p>
31.   <p id="p4">
32.     line-height: 1.3; line-height: 1.3; line-height: 1.3;
33.     line-height: 1.3; line-height: 1.3; line-height: 1.3;
34.     line-height: 1.3; line-height: 1.3; line-height: 1.3;
35.   </p>
36.   <p id="p5">
37.     line-height: 1.5; line-height: 1.5; line-height: 1.5;
38.     line-height: 1.5; line-height: 1.5; line-height: 1.5;
39.     line-height: 1.5; line-height: 1.5; line-height: 1.5;
40.   </p>
41.   <p id="p6">
42.     line-height: 2; line-height: 2; line-height: 2; line-height: 2;
43.     line-height: 2; line-height: 2; line-height: 2; line-height: 2;
44.     line-height: 2; line-height: 2; line-height: 2; line-height: 2;
45.   </p>
46. </body>
47. </html>
```

The code above will render the following:



line-height: normal; line-height: normal; line-height: normal;
line-height: normal; line-height: normal; line-height: normal;
line-height: normal; line-height: normal; line-height: normal;

line-height: 1; line-height: 1; line-height: 1; line-height: 1;
line-height: 1; line-height: 1; line-height: 1; line-height: 1;
line-height: 1; line-height: 1; line-height: 1; line-height: 1;

line-height: 1.1; line-height: 1.1; line-height: 1.1; line-height:
1.1; line-height: 1.1; line-height: 1.1; line-height: 1.1; line-
height: 1.1; line-height: 1.1;

line-height: 1.2; line-height: 1.2; line-height: 1.2; line-height:
1.2; line-height: 1.2; line-height: 1.2; line-height: 1.2; line-
height: 1.2; line-height: 1.2;

line-height: 1.3; line-height: 1.3; line-height: 1.3; line-height:
1.3; line-height: 1.3; line-height: 1.3; line-height: 1.3; line-
height: 1.3; line-height: 1.3;

line-height: 1.5; line-height: 1.5; line-height: 1.5; line-height:
1.5; line-height: 1.5; line-height: 1.5; line-height: 1.5; line-
height: 1.5; line-height: 1.5;

line-height: 2; line-height: 2; line-height: 2; line-height: 2;
line-height: 2; line-height: 2; line-height: 2; line-height: 2;
line-height: 2; line-height: 2; line-height: 2; line-height: 2;

For more on `line-height`, see <https://developer.mozilla.org/en-US/docs/Web/CSS/line-height>.



8.8. font

`font` is a shorthand property that encompasses the properties we have discussed in this lesson.

Shorthand Properties

Shorthand properties set multiple CSS properties at once, allowing for more concise, more readable stylesheets that save time and space. Using shorthand properties instead of longhand properties also has the benefit of reducing file size, which increases download speed.

An important thing to note about shorthand properties is that any unspecified values will be set to their default values.

The syntax for `font` is shown below. The highlighted properties are required:

```
font: font-style  
      font-variant  
      font-weight  
      font-stretch  
font-size/line-height  
font-family;
```

Evaluation
Copy

Some notes:

1. `font-stretch`, while well supported by browsers, only works with a small number of fonts.³⁶
2. `font-style`, `font-variant`, `font-weight`, and `font-stretch` are optional and may be written in any order before `font-size`.
3. `line-height` is also optional, but it must be written immediately after `font-size` separated by a forward slash (/).
4. If one of the optional values is not included, it will be set to the default value, overriding any rules with lower precedence.

The code below illustrates the use of `font`:

36. See <https://developer.mozilla.org/en-US/docs/Web/CSS/font-stretch>.

Demo 8.11: Fonts/Demos/font-styles.css

```
1. #div1 h1 {  
2.   font: italic small-caps bold 2em Georgia, Times,  
3.   'Times New Roman', sans-serif;  
4. }  
5.  
6. #div1 p {  
7.   font: 1em/1.2 Arial, Helvetica, sans-serif;  
8. }  
9.  
10. #div2 h1 {  
11.   font-style: italic; /* gets overridden */  
12.   font-variant: small-caps; /* gets overridden */  
13.   font: 2.5em 'Gill Sans', serif;  
14. }  
15.  
16. #div2 p {  
17.   font: 0.9em/1.5 cursive;  
18. }
```

Notice that the `font-style` and `font-variant` declarations written in the `#div2 h1` rule will not be applied because they were later overridden by defaults in the `font` declaration, even though those defaults are not explicitly stated.

Demo 8.12: Fonts/Demos/font.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <div id="div1">  
12.     <h1>Div 1</h1>  
13.     <p>  
14.       Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
15.       Maecenas euismod tellus lorem, vitae convallis nulla  
16.       facilisis vel. Nam blandit vulputate elit, ac accumsan  
17.       elit suscipit vel. Phasellus nec metus libero.  
18.     </p>  
19.   </div>  
20.   <div id="div2">  
21.     <h1>Div 2</h1>  
22.     <p>  
23.       Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
24.       Maecenas euismod tellus lorem, vitae convallis nulla  
25.       facilisis vel. Nam blandit vulputate elit, ac accumsan  
26.       elit suscipit vel. Phasellus nec metus libero.  
27.     </p>  
28.   </div>  
29. </body>  
30. </html>
```

Evaluation
Copy

The code above will render the following:

The screenshot shows a web browser window with the title bar 'font'. The address bar displays 'File | https/Demos/font.html'. The content area contains two sections: 'DIV 1' and 'Div 2'. 'DIV 1' uses a bold, italicized serif font. 'Div 2' uses a bold, italicized sans-serif font. Both sections contain placeholder text.

DIV 1

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Maecenas euismod tellus lorem, vitae convallis nulla facilisis vel. Nam blandit vulputate elit, ac accumsan elit suscipit vel. Phasellus nec metus libero.

Div 2

***L**orem ipsum dolor sit amet, consectetur adipiscing élit. Maecenas euismod tellus lorem, vitae convallis nulla facilisis vel. Nam blandit vulputate élit, ac accumsan élit suscipit vel. Phasellus nec metus libero.*

For more on font, see <https://developer.mozilla.org/en-US/docs/Web/CSS/font>.



Exercise 11: Styling Fonts

25 to 40 minutes

In this exercise, you will modify an HTML page by applying the font properties you just learned.

1. Open Fonts/Exercises/index.html in your editor. You will see the home page for a website called Runners Home.
2. Create an external stylesheet called styles.css and link to it from index.html.
3. Using your new knowledge of font properties, add some styles to this page. The object of this exercise is to practice using the font properties covered in this lesson. You are also welcome to download a font and use @font-face.
4. When you are done, open index.html in your browser to see the results. You are welcome to go back to the code and continue to work.

You can design it however you like, or you can try to make it look something like this:

Runners Home

- [Home](#)
- [Resources](#)
 - [Calculator](#)
 - [Running Log](#)
 - [Running Terms](#)
 - [Links](#)
- [Running Advice](#)
- [Races](#)
- [Register](#)

Hello, Stranger!

Welcome to Runners Home

BEST RUNNING TIPS

There are good ways to train and bad ways to train. To great the most out of your runs... [Read more...](#)

BEST HEALTH TIPS

In addition to keeping up with your physical training, you must be sure to take care of your general health... [Read more...](#)

[More advice articles...](#)

Purpose

Runners Home is dedicated to providing you with:

1. [the most up-to-date information on running races.](#)
2. [the best resources for runners.](#)

Newsletter

Email: [Sign Up](#)

Be the first to hear about our great offers.
Sign up for our newsletter today!

Disclosure: This is not a real website.

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info@runners-home.com

Solution: Fonts/Solutions/styles.css

```
1.  html {
2.    font-size: 16px;
3.  }
4.
5.  body {
6.    font: 1rem/1.3 Verdana, Geneva, Tahoma, sans-serif;
7.  }
8.
9.  #welcome {
10.   font-size: larger;
11. }
12.
13. article h2 {
14.   font-variant: small-caps;
15. }
16.
17. article p {
18.   line-height: 2;
19. }
20.
21. aside label {
22.   font-weight: bold;
23. }
24.
25. footer {
26.   font-size: smaller;
27.   font-style: italic;
28. }
```

Evaluation
Copy

Conclusion

In this lesson, you have learned to use CSS font properties.

LESSON 9

CSS Text

Topics Covered

- letter-spacing
- text-align
- text-decoration
- text-indent
- text-shadow
- text-transform
- white-space
- word-break
- word-spacing

Evaluation
Copy

Introduction

In this lesson, you will learn to use CSS properties for formatting text.



9.1. letter-spacing

The `letter-spacing` property is used to specify the amount of space between letters. The amount indicated is in addition to the default spacing. The property either takes the keyword `normal`, which is the default defined by the current font and/or browser, or a length value. See the following example:

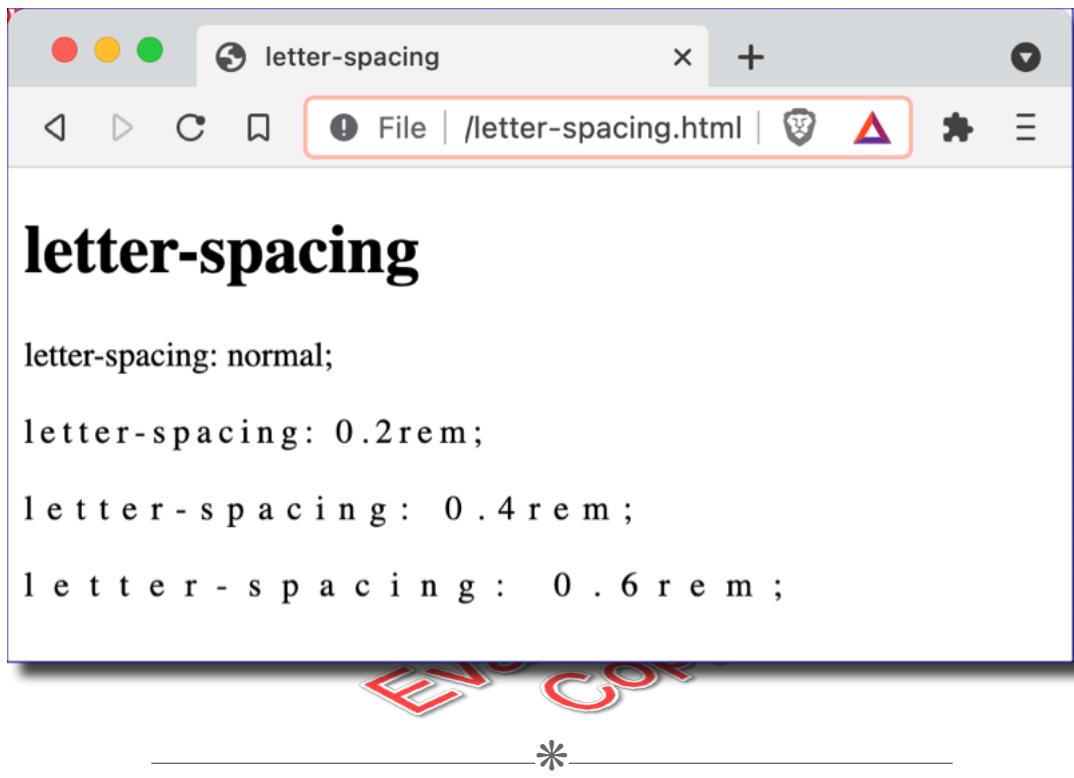
Demo 9.1: CssText/Demos/letter-spacing-styles.css

```
1. #normal {  
2.   letter-spacing: normal;  
3. }  
4.  
5. #wide {  
6.   letter-spacing: 0.2rem;  
7. }  
8.  
9. #wider {  
10.   letter-spacing: 0.4rem;  
11. }  
12.  
13. #widest {  
14.   letter-spacing: 0.6rem;  
15. }
```

Demo 9.2: CssText/Demos/letter-spacing.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1>letter-spacing</h1>  
12.   <div id="normal">letter-spacing: normal;</div>  
13.   <br>  
14.   <div id="wide">letter-spacing: 0.2rem;</div>  
15.   <br>  
16.   <div id="wider">letter-spacing: 0.4rem;</div>  
17.   <br>  
18.   <div id="widest">letter-spacing: 0.6rem;</div>  
19. </body>  
20. </html>
```

The code above will render the following:



A screenshot of a web browser window titled "letter-spacing". The address bar shows the URL "/letter-spacing.html". The page content displays the word "letter-spacing" in a large, bold, black font. Below it, four lines of CSS code are shown, each setting the letter-spacing property to different values: "normal", "0.2rem", "0.4rem", and "0.6rem". The browser interface includes standard window controls (red, yellow, green buttons) and a toolbar with icons for file operations.

```
letter-spacing: normal;  
letter-spacing: 0.2rem;  
letter-spacing: 0.4rem;  
letter-spacing: 0.6rem;
```

9.2. text-align

The `text-align` property is used to specify how inline content should be aligned horizontally within a block. The values are listed below:

- `left`
- `right`
- `center`
- `justify`

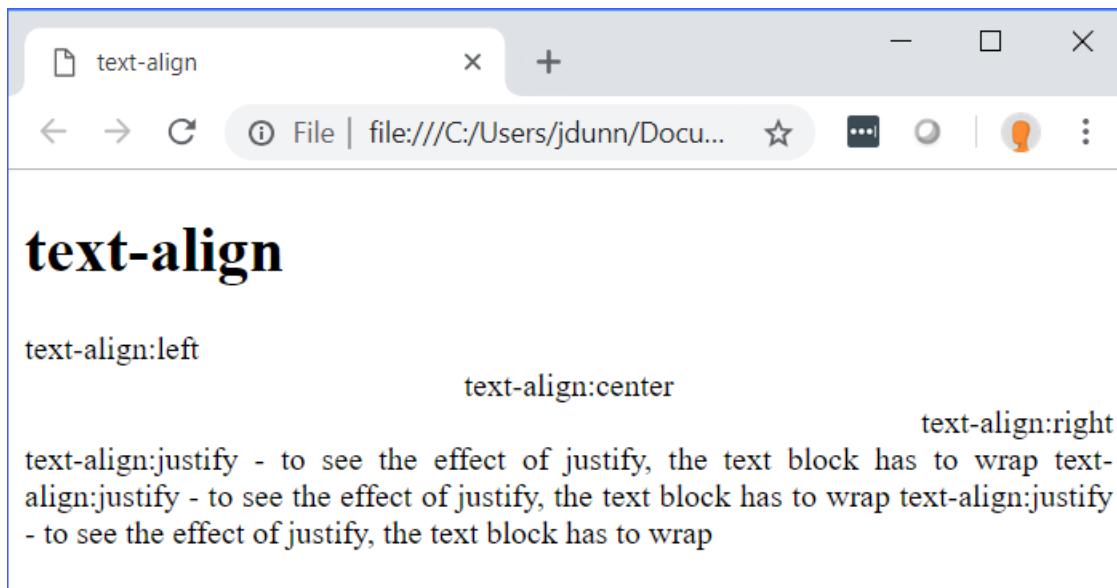
Demo 9.3: CssText/Demos/text-align-styles.css

```
1.   .left {
2.     text-align: left;
3.   }
4.
5.   .center {
6.     text-align: center;
7.   }
8.
9.   .right {
10.    text-align: right;
11.   }
12.
13.  .justify {
14.    text-align: justify;
15. }
```

Demo 9.4: CssText/Demos/text-align.html

```
-----Lines 1 through 8 Omitted-----
9.  <body class="webucator">
10. <h1>text-align</h1>
11. <div class="left">text-align:left</div>
12. <div class="center">text-align:center</div>
13. <div class="right">text-align:right</div>
14. <div class="justify">
15.   text-align:justify - to see the effect of justify,
16.   the text block has to wrap
17.   text-align:justify - to see the effect of justify,
18.   the text block has to wrap
19.   text-align:justify - to see the effect of justify,
20.   the text block has to wrap
21. </div>
22. </body>
23. </html>
```

The code above will render the following:



9.3. text-decoration

*
**Evaluation
Copy**

The **text-decoration** property is used to add effects to text, such as underlines and line-throughs. The values are listed below:

- **none**
- **underline**
- **overline**
- **line-through**

The **none** value of the **text-decoration** property can be used to remove the underline from links, as shown below:

```
a {  
    text-decoration: none;  
}
```

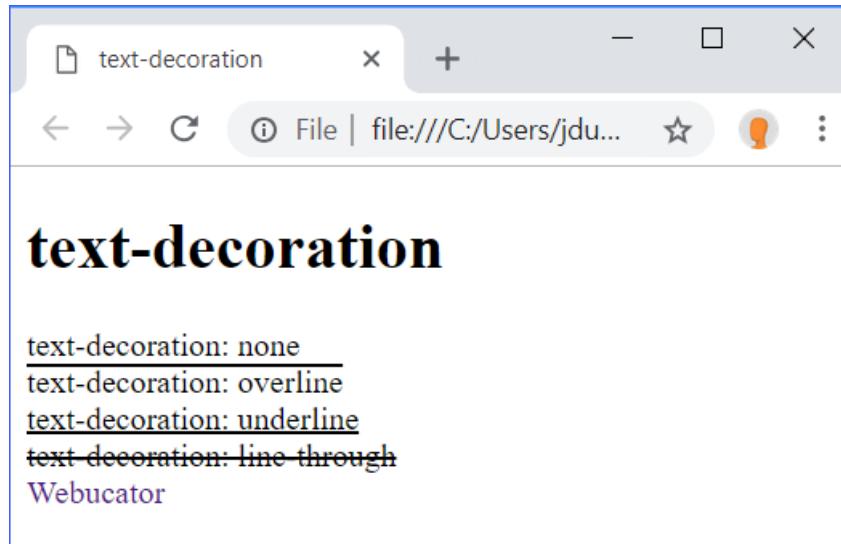
Demo 9.5: CssText/Demos/text-decoration-styles.css

```
1.   .none {
2.     text-decoration: none;
3.   }
4.
5.   .overline {
6.     text-decoration: overline;
7.   }
8.
9.   .underline {
10.    text-decoration: underline;
11.  }
12.
13.  .line-through {
14.    text-decoration: line-through;
15. }
```

Demo 9.6: CssText/Demos/text-decoration.html

```
-----Lines 1 through 8 Omitted-----
9. <body class="webucator">
10.   <h1>text-decoration</h1>
11.   <div class="none">text-decoration: none</div>
12.   <div class="overline">text-decoration: overline</div>
13.   <div class="underline">text-decoration: underline</div>
14.   <div class="line-through">text-decoration: line-through</div>
15.   <div><a href="https://www.webucator.com" class="none">
16.     Webucator</a>
17.   </div>
18. </body>
19. </html>
```

The code above will render the following:



Note how we have removed the underline from the link using `text-decoration: none`.

`text-decoration` is actually a shorthand property for the following longhand properties:

1. `text-decoration-line`: Values include `none`, `underline`, `overline`, and `line-through`.
2. `text-decoration-color`: Any valid color.
3. `text-decoration-style`: Values include `solid`, `double`, `dotted`, `dashed`, and `wavy`.
4. `text-decoration-thickness`: Values can be a length (e.g., `3px`), a percentage (e.g., `10%`), or a keyword (e.g., `auto` or `from-font`).

For more details on `text-decoration`, see <https://developer.mozilla.org/en-US/docs/Web/CSS/text-decoration>.



9.4. text-indent

The `text-indent` property is used to indent (or outdent) the first line of a block of text. The value can be specified in number of units or in percentage of the width of the containing block.

The following code sample shows the effects of `text-indent`:

Demo 9.7: CssText/Demos/text-indent-styles.css

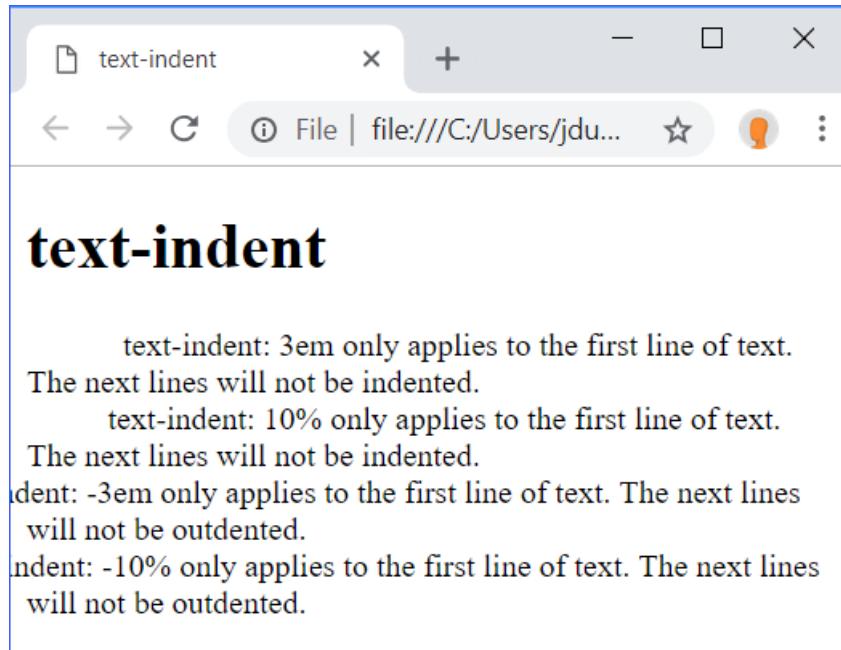
```
1. .indent-length {  
2.   text-indent: 3em;  
3. }  
4.  
5. .indent-percentage {  
6.   text-indent: 10%;  
7. }  
8.  
9. .outdent-length {  
10.  text-indent: -3em;  
11. }  
12.  
13. .outdent-percentage {  
14.  text-indent: -10%;  
15. }
```

Demo 9.8: CssText/Demos/text-indent.html

-----Lines 1 through 8 Omitted-----

```
9. <body class="webucator">  
10.   <h1>text-indent</h1>  
11.   <div class="indent-length">  
12.     text-indent: 3em only applies to the first line of text.  
13.     The next lines will not be indented.  
14.   </div>  
15.   <div class="indent-percentage">  
16.     text-indent: 10% only applies to the first line of text.  
17.     The next lines will not be indented.  
18.   </div>  
19.   <div class="outdent-length">  
20.     text-indent: -3em only applies to the first line of text.  
21.     The next lines will not be outdented.  
22.   </div>  
23.   <div class="outdent-percentage">  
24.     text-indent: -10% only applies to the first line of text.  
25.     The next lines will not be outdented.  
26.   </div>  
27. </body>  
28. </html>
```

The code above will render the following:



Note how the outdenting moves some of the content out of the viewport. Normally, you would add padding on the left to prevent this from happening. We will learn how to do that in a later lesson.

Evaluation
Copy

9.5. text-shadow

The `text-shadow` property is used to add shadow to text. It can take a comma-delimited list of shadows, each described by a combination of x and y offsets, blur radius, and color. The syntax is shown below:

```
text-shadow: x-offset y-offset blur-radius color /* shadow1 */,  
            x-offset y-offset blur-radius color /* shadow2 */,  
            x-offset y-offset blur-radius color /* shadow3 */
```

The values are explained below:

1. **x-offset** and **y-offset** – Required length values. **x-offset** must come immediately before **y-offset**. **x-offset** specifies the horizontal displacement (positive values to the right and negative values to the left). **y-offset** specifies the vertical displacement (positive values below and negative values above). If both values are zero, the shadow will be directly behind the text.

2. `blur-radius` – An optional length value that specifies the size of the blur effect. If included, this value must come after the two offset values.
3. `color` – An optional color value that has to be either the first value included or the last value. If not included, the browser picks the color, so for consistency across browsers, it is a good idea to specify the shadow's color.

Demo 9.9: CssText/Demos/text-shadow-styles.css

```
1. #simple-shadow {  
2.   color: yellow;  
3.   text-shadow: -.1rem -.1rem blue;  
4. }  
5.  
6. #blurred-shadow {  
7.   text-shadow: .1rem .1rem .25rem red;  
8. }  
9.  
10. #double-shadow {  
11.   color: red;  
12.   text-shadow: .1rem .1rem white,  
13.     .2rem .2rem blue;  
14. }
```

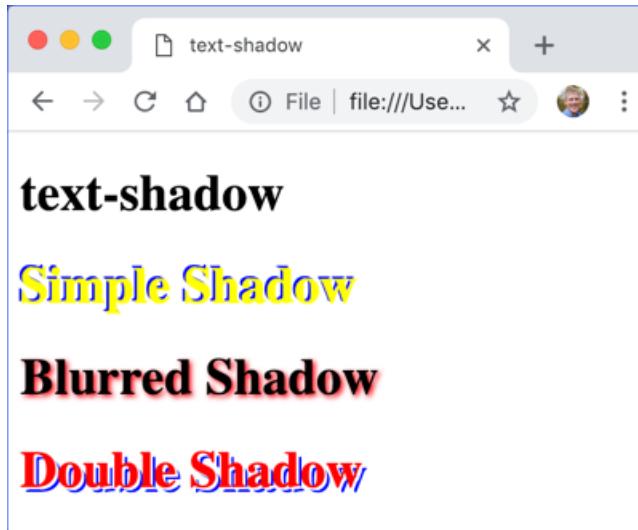


Demo 9.10: CssText/Demos/text-shadow.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1>text-shadow</h1>  
12.   <h1 id="simple-shadow">Simple Shadow</h1>  
13.   <h1 id="blurred-shadow">Blurred Shadow</h1>  
14.   <h1 id="double-shadow">Double Shadow</h1>  
15. </body>  
16. </html>
```

The code above will render the following:³⁷

³⁷. If you are reading this in black and white, be sure to open the page in your browser to see the color effects.



Evaluation
Copy

9.6. text-transform

The `text-transform` property is used to change the capitalization of text. The most common values are listed below:

- `none`
- `capitalize`
- `uppercase`
- `lowercase`

The following code sample shows the effects of `text-transform`:

Demo 9.11: CssText/Demos/text-transform-styles.css

```
1. #none {
2.   text-transform: none;
3. }
4.
5. #caps {
6.   text-transform: capitalize;
7. }
8.
9. #lower {
10.   text-transform: lowercase;
11. }
12.
13. #upper {
14.   text-transform: uppercase;
15. }
```

Demo 9.12: CssText/Demos/text-transform.html

-----Lines 1 through 9 omitted-----

```
10. <body class="webucator">
11.   <h1>text-transform</h1>
12.   <div id="none">text-transform: none;</div><br>
13.   <div id="caps">text-transform: capitalize;
14.     - this is written in all lowercase letters
15.   </div><br>
16.   <div id="lower">text-transform: lowercase;
17.     - THIS IS WRITTEN IN ALL UPPERCASE LETTERS
18.   </div><br>
19.   <div id="upper">text-transform: uppercase;
20.     - this is written in all lowercase letters
21.   </div>
22. </body>
23. </html>
```

The code above will render the following:

The screenshot shows a browser window with the title "text-transform". The content area displays four examples of text transformation:

- `text-transform: none;`
- `Text-Transform: Capitalize; - This Is Written In All Lowercase Letters`
- `text-transform: lowercase; - this is written in all uppercase letters`
- `TEXT-TRANSFORM: UPPERCASE; - THIS IS WRITTEN IN ALL LOWERCASE LETTERS`

Notice in the last two examples that the lowercase letters have been transformed to uppercase, and the uppercase letters have been transformed to lowercase.

9.7. white-space

The `white-space` property determines how sequences of whitespace are displayed. Below we list the most common values of the `white-space` property and their effects:

1. normal

- Collapses adjacent spaces and tabs.
- Collapses line breaks.
- Wraps to fit containing box.

2. nowrap

- Collapses adjacent spaces and tabs.
- Collapses line breaks.
- Does not wrap to fit containing box.

3. `pre`

- Does not collapse adjacent spaces and tabs.
- Does not collapse line breaks.
- Does not wrap to fit containing box.

4. `pre-line`

- Collapses adjacent spaces and tabs.
- Does not collapse line breaks.
- Wraps to fit containing box.

5. `pre-wrap`

- Does not collapse adjacent spaces and tabs.
- Does not collapse line breaks.
- Wraps to fit containing box.

The following code sample shows the effects of `white-space`:

Demo 9.13: CssText/Demos/white-space-styles.css

```
1. #normal {  
2.   white-space: normal;  
3. }  
4.  
5. nowrap {  
6.   white-space: nowrap;  
7. }  
8. pre {  
9.   white-space: pre;  
10. }  
11.  
12. pre-line {  
13.   white-space: pre-line;  
14. }  
15.  
16. pre-wrap {  
17.   white-space: pre-wrap;  
18. }
```

Demo 9.14: CssText/Demos/white-space.html

```
-----Lines 1 through 9 Omitted-----
10. <body class="webucator">
11.   <h1>white-space</h1>
12.   <div id="normal">
13.     white-space: normal;
14.     white-space: normal;
15.     white-space: normal; white-space: normal; white-space: normal; white-space:
16.       normal;
17.     white-space: normal; white-space: normal;
18.   </div>
19.   <hr>
20.   <div id="nowrap">
21.     white-space: nowrap;
22.     white-space: nowrap;
23.     white-space: nowrap; white-space: nowrap; white-space: nowrap; white-space:
24.       nowrap;
25.     white-space: nowrap; white-space: nowrap;
26.   </div>
27.   <hr>
28.   <div id="pre">
29.     white-space: pre;
30.     white-space: pre;
31.     white-space: pre; white-space: pre; white-space: pre; white-space: pre;
32.       white-space: pre;
33.     white-space: pre-line;
34.     white-space: pre-line;
35.       white-space: pre-line;
36.   </div>
37.   <hr>
38.   <div id="pre-wrap">
39.     white-space: pre-wrap;
40.     white-space: pre-wrap;
41.       white-space: pre-wrap; white-space: pre-wrap; white-space: pre-wrap;
42.         white-space: pre-wrap; white-space: pre-wrap;
43.   </div>
44. </body>
</html>
```

The code above will render the following:

The screenshot shows a web browser window with the title "white-space". The page content displays several examples of CSS code snippets related to the white-space property:

- white-space: normal; white-space: normal;
- white-space: nowrap; white-space: nowrap; white-space: nowrap; white-space: nowrap;
- white-space: pre;
white-space: pre;
white-space: pre; white-space: pre; white-space: pre; white-space: pre;
- white-space: pre-line;
white-space: pre-line;
white-space: pre-line;
- white-space: pre-wrap;
white-space: pre-wrap;
white-space: pre-wrap; white-space: pre-wrap; white-space: pre-wrap;
white-space: pre-wrap; white-space: pre-wrap;

Notice that the user would need to scroll right to see the content that we have forced not to wrap.



9.8. word-break

The `word-break` property specifies where it is permissible to have line breaks when text would otherwise overflow its content box. The most common values are explained below:

1. `normal` -- default line breaks (at the end of words or at hyphens)
2. `break-all` -- line breaks can happen between any two characters

The following example shows the effects of `word-break`:

Demo 9.15: CssText/Demos/word-break-styles.css

```
1. #div1 {  
2.   word-break: normal;  
3. }  
4.  
5. #div2 {  
6.   word-break: break-all;  
7. }
```

Demo 9.16: CssText/Demos/word-break.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1>word-break</h1>  
12.   <div id="div1">  
13.     <p><strong>word-break: normal;</strong> When in the Course of human  
14.       events, it becomes necessary for one people to dissolve the  
15.       political bands which have connected them with another, and to  
16.       assume among the powers of the earth, the separate and equal station  
17.       to which the Laws of Nature and of Nature's God entitle them, a  
18.       decent respect to the opinions of mankind requires that they should  
19.       declare the causes which impel them to the separation..</p>  
20.   </div>  
21.   <hr>  
22.   <div id="div2">  
23.     <p><strong>word-break: break-all;</strong> When in the Course of  
24.       human events, it becomes necessary for one people to dissolve the  
25.       political bands which have connected them with another, and to  
26.       assume among the powers of the earth, the separate and equal station  
27.       to which the Laws of Nature and of Nature's God entitle them, a  
28.       decent respect to the opinions of mankind requires that they should  
29.       declare the causes which impel them to the separation.</p>  
30.   </div>  
31. </body>  
32. </html>
```

The code above will render the following:

The screenshot shows a web browser window with the title "word-break". The address bar displays "File | os/word-break.html". The content area contains two examples of the `word-break` property.

word-break: normal; When in the Course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation..

word-break: break-all; When in the Course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation.

Notice that in the second rendering of the paragraph, some of the wrapping splits in the middle of a word (e.g., "separate").

*

9.9. word-spacing

The `word-spacing` property is used to specify the amount of space between words. The amount indicated is in addition to the default spacing. The property either takes the keyword `normal`, which is the default defined by the current font and/or browser, or a length value. See the following example:

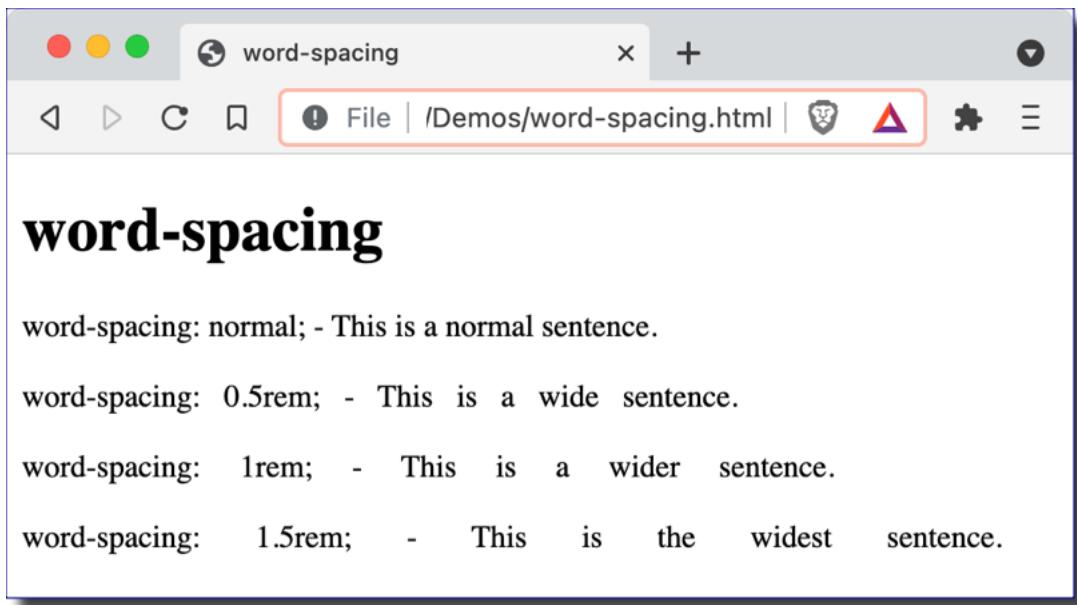
Demo 9.17: CssText/Demos/word-spacing-styles.css

```
1. #normal {  
2.   word-spacing: normal;  
3. }  
4.  
5. #wide {  
6.   word-spacing: 0.5rem;  
7. }  
8.  
9. #wider {  
10.   word-spacing: 1rem;  
11. }  
12.  
13. #widest {  
14.   word-spacing: 1.5rem;  
15. }
```

Demo 9.18: CssText/Demos/word-spacing.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1>word-spacing</h1>  
12.   <div id="normal">word-spacing: normal;  
13.     - This is a normal sentence.  
14.   </div><br>  
15.   <div id="wide">word-spacing: 0.5rem;  
16.     - This is a wide sentence.  
17.   </div><br>  
18.   <div id="wider">word-spacing: 1rem;  
19.     - This is a wider sentence.  
20.   </div><br>  
21.   <div id="widest">word-spacing: 1.5rem;  
22.     - This is the widest sentence.  
23.   </div>  
24. </body>  
25. </html>
```

The code above will render the following:



Exercise 12: Text Properties

 25 to 40 minutes

In this exercise, you will continue to work on the Runners Home page that you started in the Fonts lesson (see page 182).

1. Open `CssText/Exercises/index.html` in your editor. You will see the Runners Home home page.
2. Open `CssText/Exercises/styles.css`. This is the stylesheet from the solution to the Fonts exercise. Feel free to continue working from your own stylesheet.
3. Using your new knowledge of text properties, add some styles to this page. The object of this exercise is to practice using the text properties covered in this lesson. Feel free to use `color` and `opacity` and any other properties you have learned as well.
4. When you are done, open `index.html` in your browser to see the results. You are welcome to go back to the code and continue to work.

You can design it however you like, or you can try to make it look something like:

- Home
- Races
- Resources
- Calculator
- Running Log
- My Account
- Log out

Hello, Stranger!

Welcome to Runners Home™



Runners Home™ is dedicated to providing you with:

1. [the most up-to-date information on running races.](#)
2. [the best resources for runners.](#)

BEST RUNNING TIPS

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Solution: CssText/Solutions/styles.css

```
1.  html {
2.    font-size: 16px;
3.  }
4.
5.  body {
6.    font: 1rem/1.3 Verdana, Geneva, Tahoma, sans-serif;
7.  }
8.
9.  nav a {
10.    text-decoration: none;
11.  }
12.
13. #welcome {
14.   font-size: larger;
15. }
16.
17. #welcome h1 {
18.   color: rgb(8, 5, 211);
19.   text-shadow: 0.2rem 0.2rem 0.1rem rgb(211, 200, 238);
20. }
21.
22. article {
23.   text-align: center;
24. }
25.
26. article h2 {
27.   font-variant: small-caps;
28.   letter-spacing: 0.1em;
29.   word-spacing: 0.2em;
30. }
31.
32. article p {
33.   line-height: 2;
34.   text-align: left;
35.   text-indent: 3rem;
36. }
37.
38. .read-more {
39.   text-decoration: none;
40. }
41.
42. aside label {
43.   font-weight: bold;
44. }
```

Evaluation
Copy

```
45.  
46. #newsletter {  
47.   text-align: right;  
48. }  
49.  
50. footer {  
51.   font-size: smaller;  
52.   font-style: italic;  
53. }
```

Evaluation
Copy

Conclusion

In this lesson, you have learned to use CSS text properties.

LESSON 10

Color and Opacity

Topics Covered

color

opacity

Introduction

In this lesson, you will learn to add color and opacity to your HTML pages.



10.1. About Color and Opacity

CSS makes it really easy to add color to your HTML pages. Almost every element can have color added to it, and CSS provides multiple methods to do so. For a comprehensive list of things in CSS that can have color, see Mozilla's list of Things that can have color³⁸.

The opacity of an element is its level of opaqueness: an element with zero opacity is fully transparent. Everything that can be colored, can also have its opacity changed, and opacity can additionally affect images, which colors do not affect. Opacity and color go hand in hand, and there are several ways to apply color and opacity at the same time.



10.2. Color and Opacity Values

There are two main color models used to create colors in CSS. The first is the RGB color model, which combines **red**, **green**, and **blue** in different amounts to create a wide range of colors. The second is the HSL color model, which creates colors based on **hue**, **lightness**, and **saturation**. RGB is more popular and more commonly used.

^{38.} https://developer.mozilla.org/en-US/docs/Web/HTML/Applying_color#Things_that_can_have_color

Picking RGB and HSL Colors

Guessing RGB and HSL colors by their notations, which are explained below, is extremely difficult, and thankfully, unnecessary. There are plenty of excellent tools for selecting RGB and HSL colors from color palettes, such as Mozilla's Color picker tool³⁹.

Opacity is most commonly expressed as a percentage from 0% (invisible) to 100% (opaque), and/or a number from 0.0 (invisible) to 1.0 (opaque).

❖ 10.2.1. Color Keywords

CSS recognizes over a hundred color keywords as acceptable color values. Examples include standard colors you would expect, such as `blue`, `green`, `red`, `black`, `silver`, and `white`; and some more fun color names, such as `blanchedalmond`, `firebrick`, `floralwhite`, and `lawngreen`. For a full list of accepted color keywords see Mozilla's List of color keywords⁴⁰

❖ 10.2.2. RGB Hexadecimal Notation

RGB hexadecimal notation is the ~~Evaluation Copy~~ most commonly used type of color value. Hexadecimal digits are used to represent the amounts of each color component (red, green, and blue) ranging from 0 (00) to 255 (ff). The syntax for hexadecimal notation is below:

```
#rrggbb /* longhand */  
#rgb /* shorthand */
```

Hexadecimal Numbers

The numbering system we are all used to is base 10. To make that work, we have ten single-digit characters: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

The hexidecimal system uses base 16. So, there are sixteen single-digit characters: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, and f.

In base 10, 90 is 10 greater than 80. In base 16, 90 is 16 greater than 80, and a0 is 16 greater than 90. You count it like this:

39. https://developer.mozilla.org/en-US/docs/Web/CSS/CSS_Colors/Color_picker_tool

40. https://developer.mozilla.org/en-US/docs/Web/CSS/color_value#Color_keywords

| | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | a | b | c | d | e | f |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 1a | 1b | 1c | 1d | 1e | 1f |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 2a | 2b | 2c | 2d | 2e | 2f |
| 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 3a | 3b | 3c | 3d | 3e | 3f |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4a | 4b | 4c | 4d | 4e | 4f |
| 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 5a | 5b | 5c | 5d | 5e | 5f |
| 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 6a | 6b | 6c | 6d | 6e | 6f |
| 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 7a | 7b | 7c | 7d | 7e | 7f |
| 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 8a | 8b | 8c | 8d | 8e | 8f |
| 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 9a | 9b | 9c | 9d | 9e | 9f |
| a0 | a1 | a2 | a3 | a4 | a5 | a6 | a7 | a8 | a9 | aa | ab | ac | ad | ae | af |
| b0 | b1 | b2 | b3 | b4 | b5 | b6 | b7 | b8 | b9 | ba | bb | bc | bd | be | bf |
| c0 | c1 | c2 | c3 | c4 | c5 | c6 | c7 | c8 | c9 | ca | cb | cc | cd | ce | cf |
| d0 | d1 | d2 | d3 | d4 | d5 | d6 | d7 | d8 | d9 | da | db | dc | dd | de | df |
| e0 | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | ea | eb | ec | ed | ee | ef |
| f0 | f1 | f2 | f3 | f4 | f5 | f6 | f7 | f8 | f9 | fa | fb | fc | fd | fe | ff |

In shorthand hexadecimal notation, the six digits are cut down to three, and each digit represents two of itself. For example, #f03 would be #ff0033. Both of those notations mean that the color is made from ff of red, 00 of green, and 33 of blue. The result is sort of a rose color.

❖ 10.2.3. RGB Functional Notation

RGB colors can also be expressed in `rgb()` functional notation, which takes three parameters (`red`, `green`, and `blue`). These can either be integers from 0 to 255 or percentages from 0% to 100%. The syntax for RGB functional notation is:

```
rgb(red, green, blue)
```

❖ 10.2.4. HSL Functional Notation

HSL colors are expressed using the `hsl()` function notation. The `hsl()` function notation takes three parameters:

1. **Hue** - An angle of the color circle in degrees (`deg`), radians (`rad`), gradians (`grad`), or turns (`turn`). If units are omitted, `deg` are assumed.
 - A. `red = 0°` or `360°`
 - B. `green = 120°`

- C. blue = 240°
- 2. **Saturation** - A percentage where 100% is completely saturated (full color) and 0% is a shade of gray.
- 3. **Lightness** - A percentage where 100% is white, 50% is “normal” lightness, and 0% is black.

The syntax for `hsl()` function notation is:

```
hsl(hue, saturation, lightness)
```

`rgba()`, `hsla()`, and `#rgba`

Both RGB and HSL functional notations have ways to specify opacity (alpha) at the same time as color. Along with their respective normal notations (`rgb()` and `hsl()`), they also have alpha notations (`rgba()` and `hsla()`) that accept a fourth parameter: `alpha`, which is expressed either as a percentage from 0% to 100% or a number between 0.0 and 1.0. These are both well-supported in modern browsers.

In modern browsers (i.e., not IE), the `rgb()` and `rgba()` notations are interchangeable, meaning that `rgb()` can also take the `alpha` parameter.

You can also specify opacity using hexadecimal notation by adding the hexadecimal value for opacity at the end. For example: `#ff0033aa`.



10.3. color

`color` is the CSS property used to apply color to the *foreground* of an element. The most common example of a “foreground” is just plain old text. See the samples below:

Demo 10.1: ColorAndOpacity/Demos/color-styles.css

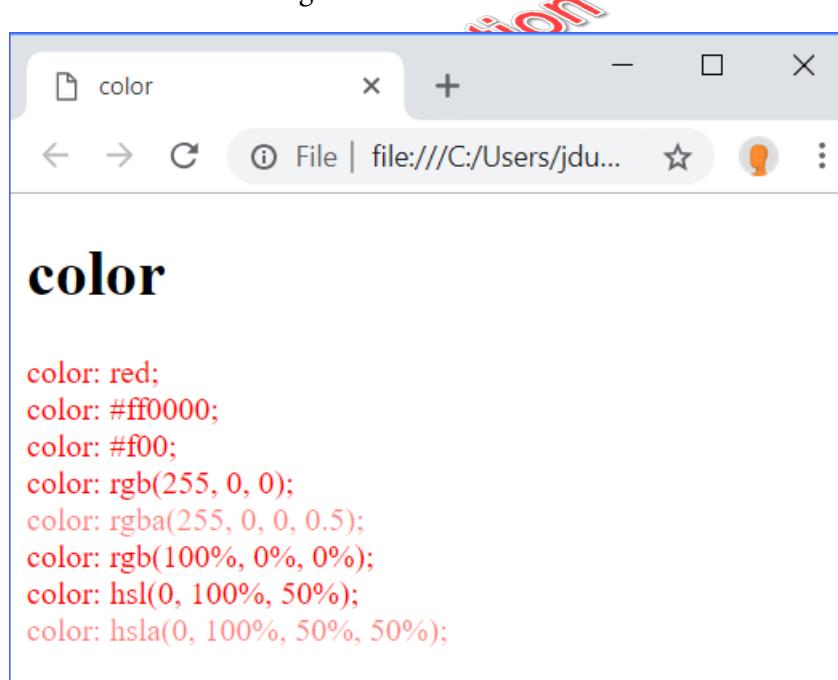
```
1.  #keyword {
2.    color: red;
3.  }
4.
5.  #rgb-longhand {
6.    color: #ff0000;
7.  }
8.
9.  #rgb-shorthand {
10.   color: #f00;
11. }
12.
13. #rgb-function-numbers {
14.   color: rgb(255, 0, 0);
15. }
16.
17. #rgb-function-percentage {
18.   color: rgb(100%, 0%, 0%);
19. }
20.
21. #rgba {
22.   color: rgba(255, 0, 0, 0.5);
23. }
24.
25. #hsl-function {
26.   color: hsl(0, 100%, 50%);
27. }
28.
29. #hsla {
30.   color: hsla(0, 100%, 50%, 50%);
31. }
```

Evaluation
Copy

Demo 10.2: ColorAndOpacity/Demos/color-demo.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1>color</h1>  
12.   <div id="keyword">color: red;</div>  
13.   <div id="rgb-longhand">color: #ff0000;</div>  
14.   <div id="rgb-shorthand">color: #f00;</div>  
15.   <div id="rgb-function-numbers">color: rgb(255, 0, 0);</div>  
16.   <div id="rgba">color: rgba(255, 0, 0, 0.5);</div>  
17.   <div id="rgb-function-percentage">color: rgb(100%, 0%, 0%);</div>  
18.   <div id="hsl-function">color: hsl(0, 100%, 50%);</div>  
19.   <div id="hsla">color: hsla(0, 100%, 50%, 50%);</div>  
20. </body>  
21. </html>
```

The code above will render the following:⁴¹



*

⁴¹. If you are reading this in black and white, be sure to open the page in your browser.

10.4. opacity

opacity is the CSS property used to set the transparency of an entire element. See the demo below:

Demo 10.3: ColorAndOpacity/Demos-opacity-styles.css

```
1. #my-div {  
2.   /* To make the changes in opacity  
3.   easier to see, we have added a yellow  
4.   background color and made the text red */  
5.   background-color: yellow;  
6.   color: red;  
7. }  
8.  
9. .invisible {  
10.   opacity: 0;  
11. }  
12.  
13. .light {  
14.   opacity: .25;  
15. }  
16.  
17. .medium {  
18.   opacity: .5;  
19. }  
20.  
21. .heavy {  
22.   opacity: .75;  
23. }  
24.  
25. .opaque {  
26.   opacity: 1;  
27. }
```

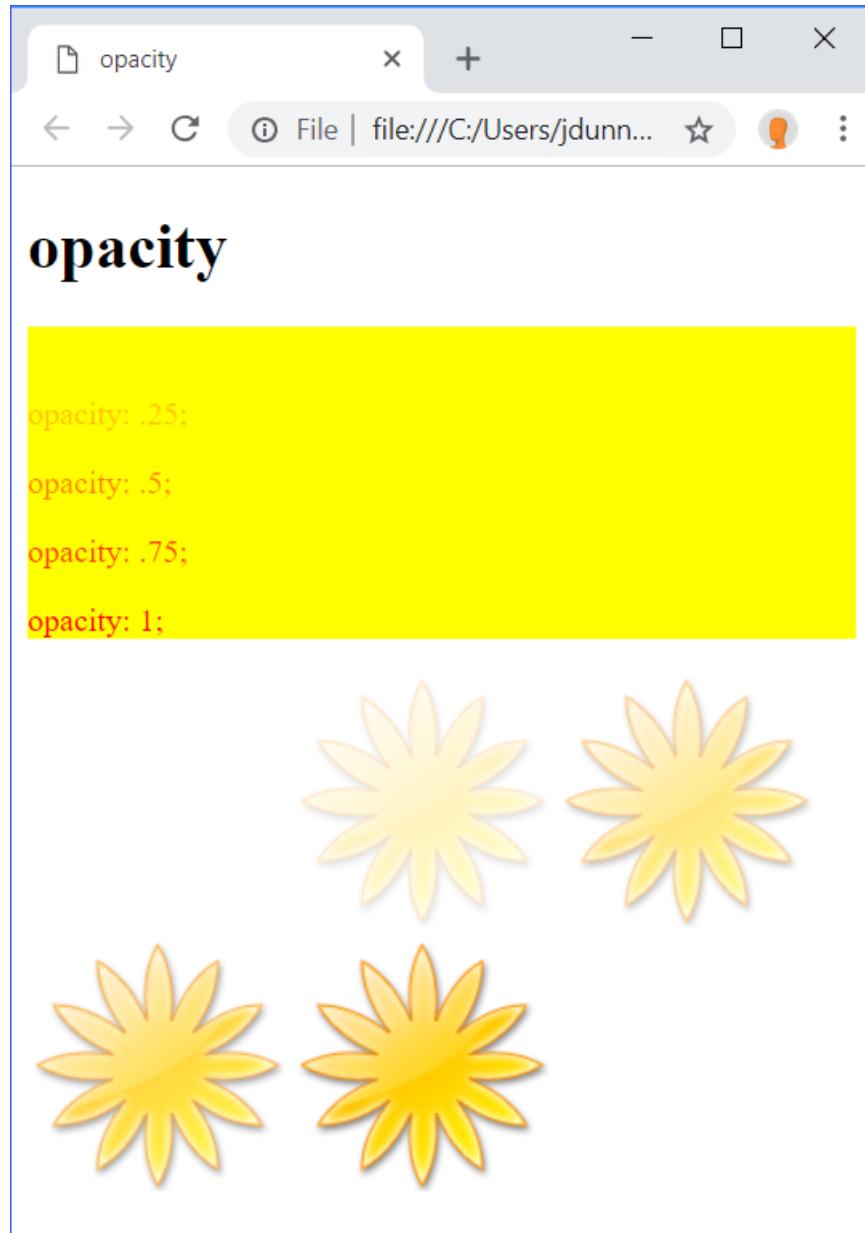


In this demo, opacity was also used to change the transparency of images. This is something that the color property cannot do as images are not affected by the color property.

Demo 10.4: ColorAndOpacity/Demos-opacity-demo.html

```
-----Lines 1 through 9 Omitted-----  
10. <body class="webucator">  
11.   <h1>opacity</h1>  
12.   <div id="my-div">  
13.     <p class="invisible">opacity: 0;</p>  
14.     <p class="light">opacity: .25;</p>  
15.     <p class="medium">opacity: .5;</p>  
16.     <p class="heavy">opacity: .75;</p>  
17.     <p class="opaque">opacity: 1;</p>  
18.   </div>  
19.     
20.     
21.     
22.     
23.     
24. </body>  
25. </html>
```

The code above will render the following:



Exercise 13: Adding Color and Opacity to Text

 25 to 40 minutes

In this exercise, you will add `color` and `opacity` properties to an HTML file containing three children's stories.

1. Open `Exercises/stories.html` in your editor.
2. Create a CSS file called `stories-styles.css` and link to it from `stories.html`.
3. Using CSS, edit the color and opacity of the different elements in `stories.html`. The object of this exercise is to practice using the `color` and `opacity` properties.
4. When you are done, open `stories.html` in your browser. You are welcome to go back to the code and keep working.

You can design it however you like, or you can try to make it look something like:⁴²

42. The images used in this section are in the public domain (https://commons.wikimedia.org/wiki/Public_domain):

- https://commons.wikimedia.org/wiki/File:Cinderella_and_the_Fairy_Godmother.jpg
- https://commons.wikimedia.org/wiki/File:Boys_and_Girls_of_Bookland_Alice_in_Wonderland.jpg
- https://commons.wikimedia.org/wiki/File:Joshua_Reynolds_-_Cupid_as_Link_Boy.jpg

Stories

- [A Mad Tea-Party](#)
- [Cinderella](#)
- [The Naughty Boy](#)

A MAD TEA-PARTY - Lewis Carroll



There was a table set out under a tree in front of the house, and the March Hare and the Hatter were having tea at it: a Dormouse was sitting between them, fast asleep, and the other two were using it as a cushion, resting their elbows on it, and talking over its head. "Very uncomfortable for the Dormouse," thought Alice; "only, as it's asleep, I suppose it doesn't mind." [Continue reading](#)

[Back to top](#)

Solution: ColorAndOpacity/Solutions/stories-styles.css

```
1.  a {
2.    color: red;
3.  }
4.
5.  a[href='#top'],
6.  h1 {
7.    color: limegreen;
8.  }
9.
10. nav a {
11.   color: hsl(300, 20%, 50%);
12. }
13.
14. h2 {
15.   font-size: 1.2em;
16.   font-style: italic;
17.   font-weight: normal;
18. }
19.
20. #cinderella h2 {
21.   color: hsl(56, 100%, 45%);
22. }
23.
24. #alice h2 {
25.   color: #f60;
26. }
27.
28. #naughtyboy h2 {
29.   color: #e96df2;
30. }
31.
32. p {
33.   color: rgb(51, 102, 102);
34.   font-family: Cambria, Cochin, Georgia, Times, serif;
35.   font-size: .9em;
36. }
37.
38. img {
39.   opacity: .5;
40. }
```



Conclusion

In this lesson, you have learned to work with color and opacity in CSS.

Evaluation Copy

LESSON 11

JavaScript Basics

Topics Covered

- The HTML DOM.
- JavaScript syntax rules.
- Inline JavaScript.
- JavaScript script blocks.
- Creating and linking to external JavaScript files.
- Working with JavaScript objects, methods, and properties.
- Referencing HTML elements.

Introduction

Evaluation
Copy

In this lesson, you will get comfortable with the basics of JavaScript.



11.1. JavaScript vs. EcmaScript

We refer to the language you are learning as *JavaScript*, which is what it is usually called. However, *JavaScript* was invented by Netscape Communications and is now owned by Oracle Corporation⁴³. Microsoft calls its version of the language *JScript*. JavaScript and JScript are both implementations of *EcmaScript*, but everyone still refers to the language as JavaScript.

❖ 11.1.1. What is ECMAScript?

ECMAScript, sometimes abbreviated as “ES”, is a scripting language specification maintained and trademarked by Ecma International (<http://www.ecma-international.org/memento/in>

^{43.} <https://en.wikipedia.org/wiki/JavaScript#Trademark>

dex.html), a Europe-based industry association dedicated to technology and communications standards. The specification for the most-recent standard version of ECMAScript can be found at:

<https://www.ecma-international.org/publications-and-standards/standards/ecma-262/>

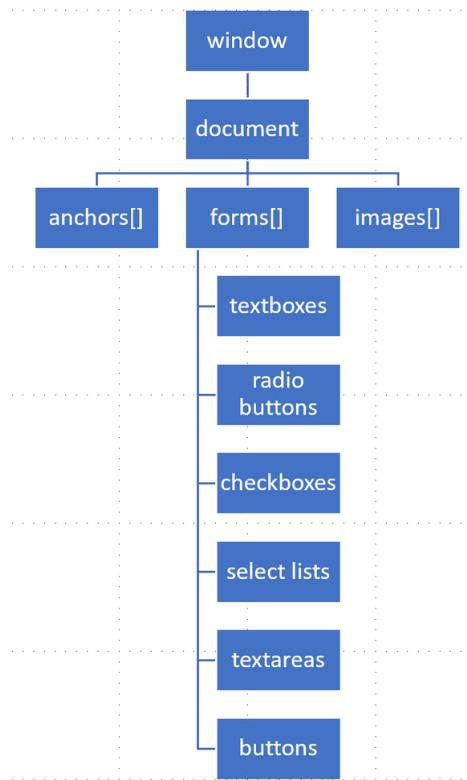
As we mentioned above, JavaScript – the scripting language you are learning here and whose code is run by the browsers you (or others) use to visit the pages you build – is an implementation of ECMAScript.

Keep in mind that ECMAScript evolves over time: new features are added, new syntax is adopted, etc. Like CSS, HTML, and other client-side technologies, JavaScript is an implementation of a standard (ECMAScript) by browsers - please be aware that all browsers won't implement (or implement in the same manner) all newer features of ECMAScript, and that later versions of browsers will implement newer features over time.



11.2. The HTML DOM

The HTML Document Object Model (DOM) is the browser's view of an HTML page as an object hierarchy, starting with the browser window itself and moving deeper into the page, including all of the elements on the page and their attributes. Below is a simplified version of the HTML DOM:



As shown, the top-level object is `window`. The `document` object is a child of `window` and all the objects (i.e., elements) that appear on the page (e.g., forms, links, images, tables, etc.) are descendants of the `document` object. These objects can have children of their own. For example, `form` objects generally have several child objects, including text boxes, radio buttons, and select menus.



11.3. JavaScript Syntax

❖ 11.3.1. Basic Rules

1. JavaScript statements end with semi-colons.
2. JavaScript is case sensitive.
3. JavaScript has two forms of comments:
 - Single-line comments begin with a double slash (`//`).
 - Multi-line comments begin with “`/*`” and end with “`*/`”.

```
// This is a single-line comment.  
  
/*  
 This is  
 a multi-line  
 comment.  
*/
```



11.4. Accessing Elements

❖ 11.4.1. Dot Notation

In JavaScript, elements (and other objects) can be referenced using dot notation, starting with the highest-level object (i.e., `window`). Objects can be referred to by name or id or by their position on the page. For example, if there is a form on the page named “`loginform`”, using dot notation you could refer to the form as follows:

`window.document.loginform`

Assuming that `loginform` is the first form on the page, you could also refer to it in this way:

`window.document.forms[0]`

A document can have multiple `form` elements as children. The number in the square brackets (`[]`) indicates the specific `form` in question. In programming speak, every `document` object contains a *collection* of forms. The length of the collection could be zero (meaning there are no forms on the page) or greater. In JavaScript, collections (and arrays) are zero-based, meaning that the first `form` on the page is referenced with the number zero (0) as shown in the syntax example above.

❖ 11.4.2. Square Bracket Notation

Objects can also be referenced using square bracket notation as shown below:

```
window[ 'document' ][ 'loginform' ]  
// and  
window[ 'document' ][ 'forms' ][ 0 ]
```

Dot notation and square bracket notation are completely interchangeable. Dot notation is much more common; however, as we will see later in the course, there are times when it is more convenient to use square bracket notation.

Evaluation
Copy

11.5. Where Is JavaScript Code Written?

JavaScript code can be written inline (e.g., within HTML attributes called *on-event handlers*), in `script` blocks, and in external JavaScript files. The page below shows examples of all three.

Demo 11.1: JavaScriptBasics/Demos/javascript.html

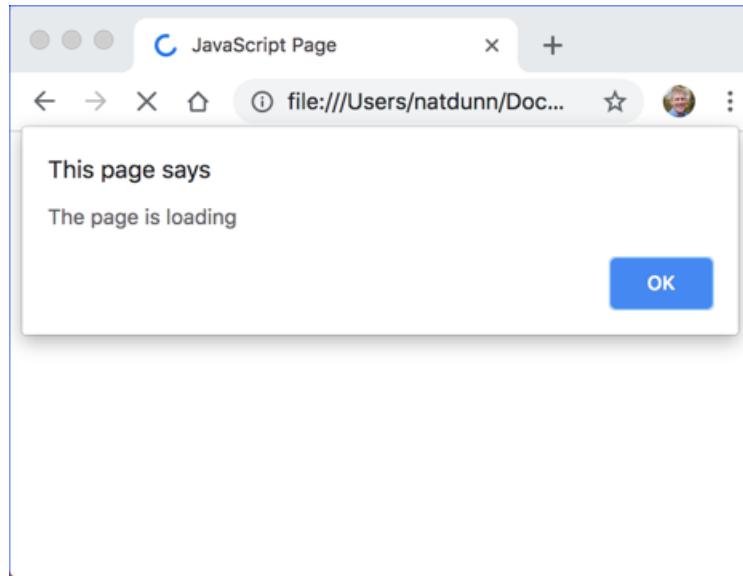
```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      //Pop up an alert
10.     window.alert("The page is loading");
11.  </script>
12.  <title>JavaScript Page</title>
13.  </head>
14.  <body>
15.  <main>
16.      <button onclick="document.body.style.backgroundColor = 'red';">
17.          Red
18.      </button>
19.      <button onclick="document.body.style.backgroundColor = 'white';">
20.          White
21.      </button>
22.      <button onclick="document.body.style.backgroundColor = 'green';">
23.          Green
24.      </button>
25.      <button onclick="document.body.style.backgroundColor = 'blue';">
26.          Blue
27.      </button>
28.      <script src="script.js"></script>
29.  </main>
30.  </body>
31. </html>
```

Evaluation
Copy

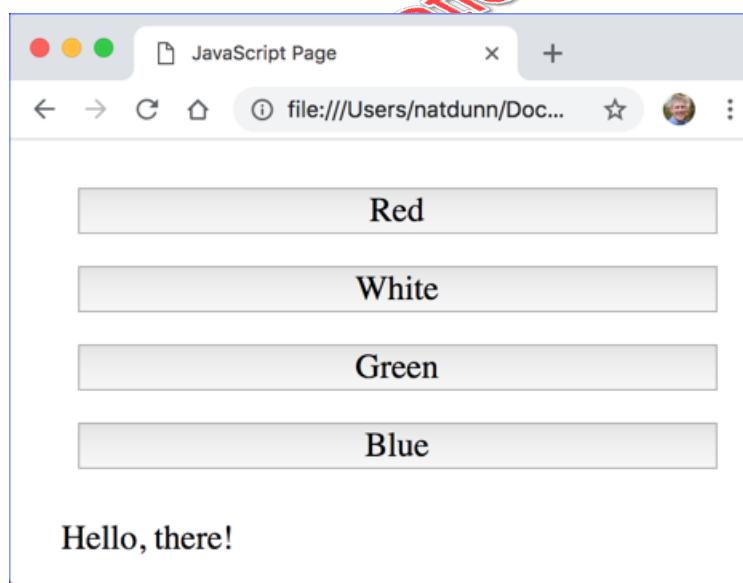
Demo 11.2: JavaScriptBasics/Demos/script.js

```
1.  /*
2.   This script simply outputs
3.   "Hello, there!"
4.   to the browser.
5.   */
6.  document.write("<p>Hello, there!</p>");
```

1. Open JavaScriptBasics/Demos/javascript.html in your browser. As the page loads, an alert will pop up that says “The page is loading” as shown below:

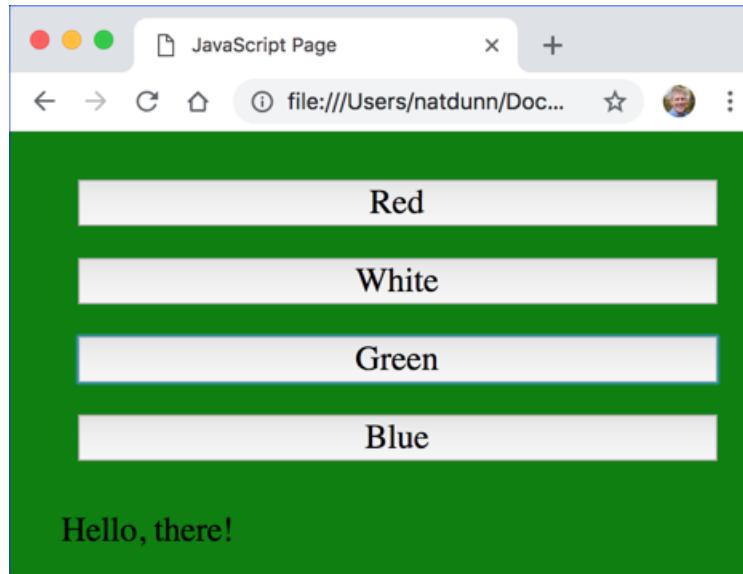


2. Click the **OK** button. The page will finish loading and will appear as follows:



The text "Hello, there!" is written dynamically by the code in `JavaScriptBasics/Demos/script.js`.

3. Click any one of the buttons. The background color of the page changes:



We will look at the code in this file and in `JavaScriptBasics/Demos/javascript.html` again shortly.

The Implicit window Object

The `window` object is always the implicit top-level object and therefore does not have to be included in references to objects. For example, `window.document.write()` can be shortened to `document.write()`. Likewise, `window.alert()` can be shortened to just `alert()`.

*

11.6. JavaScript Objects, Methods and Properties

JavaScript is used to manipulate or get information about objects in the HTML DOM. Objects in an HTML page have methods (actions, such as opening a new window or submitting a form) and properties (attributes or qualities, such as color and size).

To illustrate objects, methods and properties, let's return to the code in `JavaScriptBasics/Demos/javascript.html` and `JavaScriptBasics/Demos/script.js`. You may find it useful to have those files open in your editor while reading this section.

❖ 11.6.1. Methods

Methods are the verbs of JavaScript. They cause things to happen.

`window.alert()`

HTML pages are read and processed from top to bottom. The JavaScript code in the initial `script` block at the top of `JavaScriptBasics/Demos/javascript.html` calls the `alert()` method of the `window` object. When the browser reads that line of code, it will pop up an alert box and will not continue processing the page until the user presses the `OK` button. Once the user presses the button, the alert box disappears and the rest of the page loads.

Note that, because `window` is the implicit top-level object, we could leave it off and just write `alert("The page is loading")`. And, in fact, this is the way it is usually done.

`document.write()`

The `write()` method of the `document` object is used to write out code to the page as it loads. In `JavaScriptBasics/Demos/script.js`, it simply writes out "Hello, there!"; however, it is more often used to write out dynamic data, such as the date and time on the user's machine.

The `document` object is a child of `window`, so we could write `window.document.write('some text')`, but again, `window` is implicit.

Arguments

Methods can take zero or more arguments separated by commas.

```
object.method(argument1, argument2);
```

The `alert()` and `write()` methods shown in the example above each take only one argument: the message to show or the HTML to write out to the browser.

❖ 11.6.2. Properties

Properties are the adjectives of JavaScript. They describe qualities of objects and, in some cases are writable (can be changed dynamically).

`document.body.style.backgroundColor`

The `body` object is a property of the `document` object, the `style` object is a property of the `body` object, and `backgroundColor` is a read-write property of the `style` object. To understand what's going on, it can be useful to read the dot notation from right to left: "The `backgroundColor` style of the `body` of the `document`."

Looking back at `JavaScriptBasics/Demos/javascript.html`, the four button elements use the `onclick` on-event handler to catch click events. When the user clicks a button, JavaScript is used to set the background of the body to a new color, in the same way that we might use CSS to style the page with `background-color:red` or `background-color:white`.

Exercise 14: Alerts, Writing, and Changing Background Color

 5 to 15 minutes

In this exercise, you will practice using JavaScript to pop up an alert, write text to the screen, and set the background color of the page.

1. Open `JavaScriptBasics/Exercises/alert-write-bgcolor.html` for editing.
2. In the head of the file, add a JavaScript alert which pops up the message “Welcome to my page!” when the page loads.
3. Add `click` handlers to the two buttons to allow the user to change the background color of the page to red or to blue.
4. In the `script` at the bottom of the page, use JavaScript to write the text “This text was generated by JavaScript.” to the page.
5. Test your solution in a browser.

Solution: JavaScriptBasics/Solutions/alert-write-bgcolor.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    window.alert("Welcome to my page!");
10. </script>
11. <title>Alert, Write, Change Background Color</title>
12. </head>
13. <body>
14. <main>
15.   <p>Click the button to turn the page:</p>
16.   <button onclick="document.body.style.backgroundColor = 'red'">
17.     Red
18.   </button>
19.   <p>Click the button to turn the page:</p>
20.   <button onclick="document.body.style.backgroundColor = 'blue'">
21.     Blue
22.   </button>
23.   <script>
24.     document.write('This text was generated by JavaScript');
25.   </script>
26. </main>
27. </body>
28. </html>
```

Evaluation
Copy

Code Explanation

1. In the head, we use `window.alert()` to generate the pop-up. We could have just used `alert()`.
 2. We use `document.write()` to write to the screen at the bottom of the page.
 3. We use `onclick="document.body.style.backgroundColor = 'red'"` and `onclick="document.body.style.backgroundColor = 'blue'"` to add click handlers to the buttons.
-

Conclusion

In this lesson, you have learned the basics of JavaScript. Now you're ready for more.

Evaluation
Copy

LESSON 12

Variables, Arrays, and Operators

Topics Covered

- Creating, reading, and modifying variables in JavaScript.
- JavaScript arrays.
- JavaScript operators.

Introduction

In this lesson, you will learn to work with variables, arrays, and operators.

12.1. JavaScript Variables

Variables are used to hold data in memory. JavaScript variables are declared with the `let` keyword.

```
let age;
```

While this practice is discouraged, it is possible to declare multiple variables in a single step, like this:

```
let age, height, weight, dominantHand;
```

After a variable is declared, it can be assigned a value.

```
age = 18;
```

Variable declaration and assignment can be done in a single step.

```
let age = 18;
```

let versus var

If you have worked with JavaScript before, you may wonder why we are using `let` as opposed to the `var` keyword. Although `var` has not been officially deprecated, use of this keyword is discouraged primarily because variables defined with `let` cannot be accessed outside of the block where the variable is defined, thus reducing the likelihood of runtime errors caused by changing the value of a variable out of scope.⁴⁴ See the Mozilla documentation⁴⁵ for details.



12.2. A Loosely Typed Language

JavaScript is a loosely typed language. This means that you do not specify the data type of a variable when declaring it. It also means that a single variable can hold different data types at different times and that JavaScript can change the variable type on the fly.

For example, in the following block, the variable `age` is an *integer* and the variable `strAge` is a *string* (programming speak for text) because of the quotes.

```
let age = 18;  
let strAge = "18";
```

If you were to try to do a math function on `strAge` (e.g., multiply it by 4), a strongly typed (or *statically* typed) language would error saying you cannot multiply a string by a number. JavaScript would dynamically change `strAge` to an integer for the purposes of that operation. Although this is very convenient, it can also cause unexpected results, so be careful.

TypeScript

TypeScript⁴⁶ is an open-source programming language developed by Microsoft. Developers writing in TypeScript compile their code to valid JavaScript, which they can use anywhere one might use JavaScript. A useful feature of TypeScript is **static typing**, meaning that a developer might specify the type of a given variable - to be a string, say, or a Boolean true/false variable - when declaring the variable. Violations of this static typing - trying to work with a number value

44. You will learn more about scope when we cover functions.

45. <https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Statements/let>

46. <https://www.typescriptlang.org/>

as if it were a string value, for example - produces an error when compiling the TypeScript code into JavaScript, and thus adds a check against a dangerous bug creeping into the code.

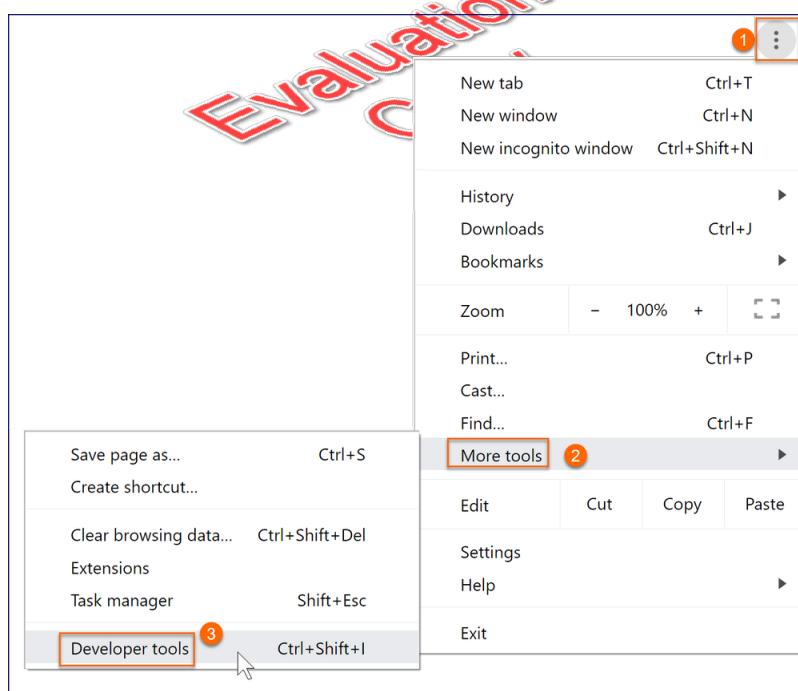


12.3. Google Chrome DevTools

Google Chrome DevTools is a set of tools to help web developers. We will use the Chrome DevTools Console to illustrate JavaScript's dynamic typing.

To open the Chrome DevTools Console:

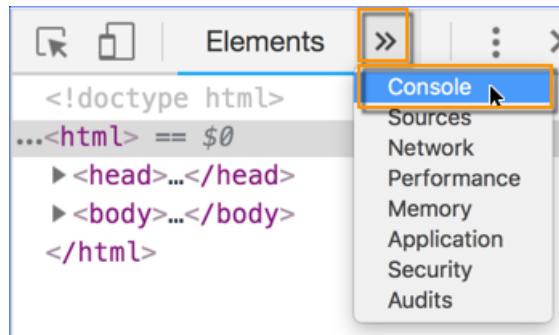
1. Click the three-vertical-dot icon in the upper right of Google Chrome.
2. Select **More Tools**.
3. Select **Developer Tools**.



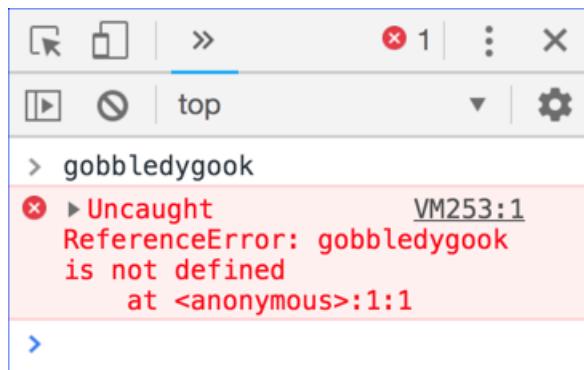
4. The tools will usually be docked on the right or bottom of your screen. Make sure that the Console is selected:



You may need to dropdown the menu to see the Console option:

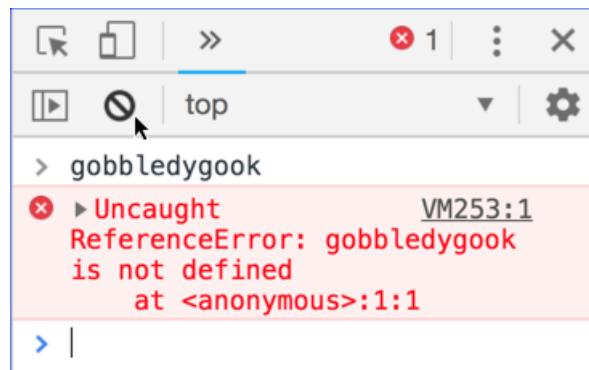


5. Now type “gobbledygook” in the Console and press **Enter**:

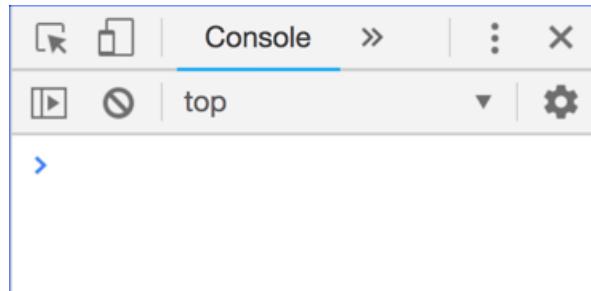


The word “gobbledygook” doesn’t mean anything in JavaScript and we have not defined a variable named “gobbledygook”, so we get an error.

6. To clear the Console, press the Clear Console icon:



7. You should now have a clear Console to start practicing JavaScript:



You can write and test JavaScript for a page directly in the Console. We will use it to show how JavaScript variables are dynamic:

1. Type `let age = 18;` and press **Enter** :

```
> let age = 18;  
< undefined  
> |
```

Don't worry about the "undefined" response. All that means is that your code didn't return anything.

2. Now type `age` ; and press **Enter** :

```
> let age = 18;  
< undefined  
> age;  
< 18  
> |
```

This time it does return something – the value of `age`.

3. Let's subtract 2 from `age` and then add 2 to `age` :

```
> age - 2;  
< 16  
> age + 2;  
< 20
```

That works as expected.

4. Now we will set `age` to '18' in single quotes. This makes `age` a string, which is programming-speak for text :

```
> age = '18';
< "18"
```

Notice that it returns "18". At this point, a strongly typed programming language would have balked. It would have told us that `age` was declared as a number and cannot be assigned a string value. You may also notice that "18" in double quotes was returned even though we used single quotes when we set the value of `age`. Single and double quotes are interchangeable in JavaScript.

5. Now let's subtract 2 from `age` :

```
> age - 2;
< 16
```

Notice that JavaScript understands that we want to treat `age` as a number and so it converts it to a number before doing the math.

6. Now let's add 2 to `age` :

```
> age + 2;
< "182"
```

Oops! What happened? As it turns out, the plus operator (+) has multiple functions in JavaScript. In addition to adding numbers together, it can add strings together. In this case, because `age` is a string, it converts 2 to a string before doing the operation. So, it's adding "18" and "2" to give us "182".

The issue shown above does not come up often, but when it does, it can bite you. The best way to handle it is to make sure that when you are going to use a variable as a new type, you explicitly convert it to the new type. We will show how to do that later in the course.

❖ 12.3.1. Variable Naming

1. Variable names must begin with a letter, underscore (_), or dollar sign (\$).
2. Variable names cannot contain spaces or special characters (other than the underscore and dollar sign).
3. Variable names can contain numbers (but not as the first character).
4. Variable names are case sensitive.

5. You cannot use keywords (e.g., window or function) as variable names.

*

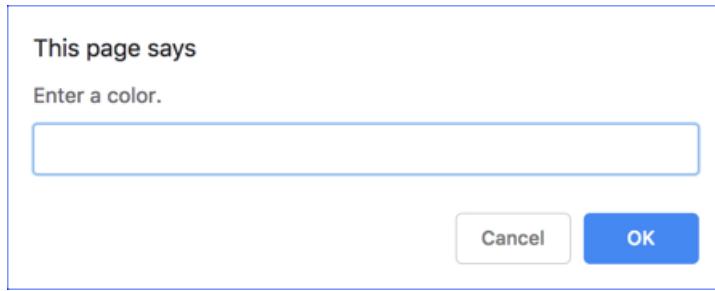
12.4. Storing User-Entered Data

The following example uses the `prompt()` method of the `window` object to collect user input. The value entered by the user is then assigned to a variable, which is accessed when the user clicks one of the button elements.

Demo 12.1: VariablesArraysOperators/Demos/variables.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      //Pop up a prompt
10.     let userColor = window.prompt("Enter a color.", "");
11. </script>
12. <title>JavaScript Variables</title>
13. </head>
14. <body>
15. <main>
16.     <button onclick="document.body.style.backgroundColor = 'red';">
17.         Red
18.     </button>
19.     <button onclick="document.body.style.backgroundColor = 'white';">
20.         White
21.     </button>
22.     <button onclick="document.body.style.backgroundColor = 'green';">
23.         Green
24.     </button>
25.     <button onclick="document.body.style.backgroundColor = 'blue';">
26.         Blue
27.     </button>
28.     <button onclick="document.body.style.backgroundColor = userColor;">
29.         <script>
30.             document.write(userColor);
31.         </script>
32.     </button>
33. </main>
34. </body>
35. </html>
```

As the page loads, a prompt pops up asking the user to enter a color.



This is done with the `prompt()` method of the `window` object. The `prompt()` method is used to get input from the user. It takes two arguments:

1. The message in the dialog box (e.g., "Enter a color.").
2. The default value that appears in the text box. In the example above this is an empty string (i.e., "").

If the **OK** button is pressed, the `prompt` returns the value entered in the text box. If the **Cancel** button, the `prompt` returns `null`.⁴⁷ The line below assigns whatever is returned to the variable `userColor`.

```
let userColor = window.prompt("Enter a color.", "");
```

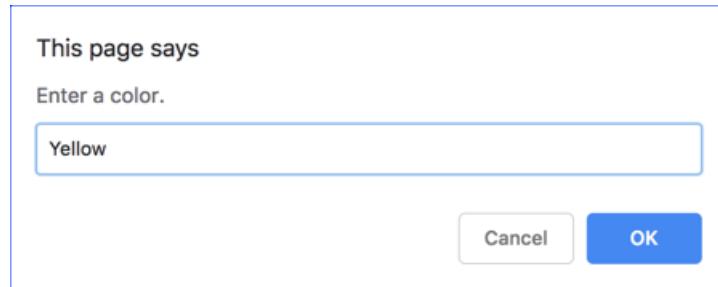
A `script` block with a call to `document.write()` is then used to output the color entered by the user. This output is contained within a `button` element, which has an `onclick` on-event handler that will be used to turn the background color of the page to the user-entered color.

```
<button  
    onclick="document.body.style.backgroundColor = userColor;">  
    <script>  
        document.write(userColor);  
    </script>  
</button>
```

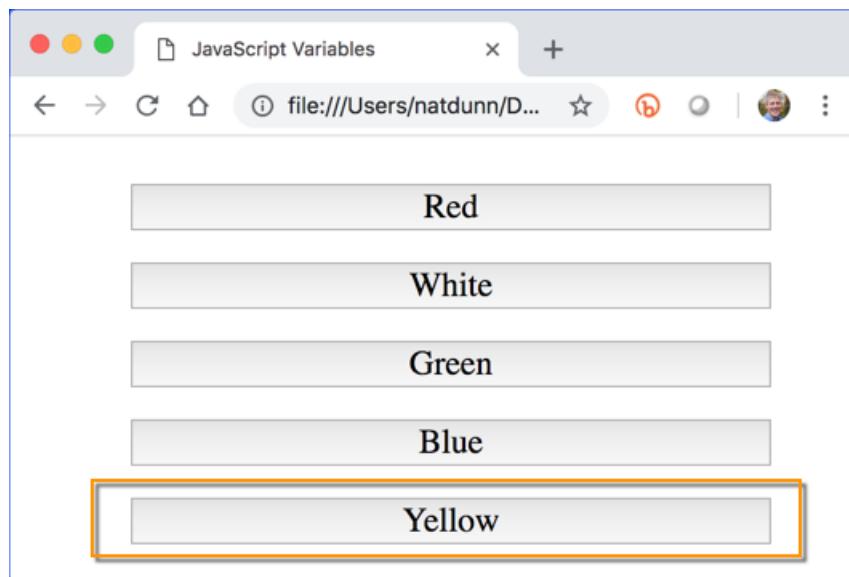
Test this out:

1. Open `VariablesArraysOperators/Demos/variables.html` in your browser and enter "Yellow" in the prompt:

⁴⁷. In JavaScript, `null` is a datatype with only one value: `null`. It represents a value that we don't know or that is missing.



2. The resulting page should appear as follows:



3. Click the "Yellow" button. The background should turn yellow.

Exercise 15: Using Variables

 5 to 15 minutes

In this exercise, you will practice using variables.

1. Open `VariablesArraysOperators/Exercises/variables.html` for editing.
2. Below the `ADD PROMPT HERE` comment, write code that will prompt the user for their first name and assign the result to a variable.
3. Add a button below the Ringo button that reads “Your Name”. Add functionality so that when this button is pressed an alert pops up showing the user’s first name.
4. Test your solution in a browser.

Exercise Code 15.1: `VariablesArraysOperators/Exercises/variables.html`

1. `<!DOCTYPE html>`
2. `<html lang="en">`
3. `<head>`
4. `<meta charset="UTF-8">`
5. `<meta name="viewport" content="width=device-width, initial-scale=1">`
6. `<link rel="stylesheet" href="../normalize.css">`
7. `<link rel="stylesheet" href="../styles.css">`
8. `<script>`
9. `//ADD PROMPT HERE`
10. `</script>`
11. `<title>JavaScript Variables</title>`
12. `</head>`
13. `<body>`
14. `<main>`
15. `<button onclick="alert('Paul');">Paul</button>`
16. `<button onclick="alert('John');">John</button>`
17. `<button onclick="alert('George');">George</button>`
18. `<button onclick="alert('Ringo');">Ringo</button>`
19. `<!--ADD BUTTON HERE-->`
20. `</main>`
21. `</body>`
22. `</html>`

Solution: VariablesArraysOperators/Solutions/variables.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    let firstName = window.prompt("What's your name?", "");
10. </script>
11. <title>JavaScript Variables</title>
12. </head>
13. <body>
14. <main>
15.   <button onclick="alert('Paul');">Paul</button>
16.   <button onclick="alert('John');">John</button>
17.   <button onclick="alert('George');">George</button>
18.   <button onclick="alert('Ringo');">Ringo</button>
19.   <button onclick="alert(firstName);">Your Name</button>
20. </main>
21. </body>
22. </html>
```

Evaluation
Copy

*

12.5. Constants

In programming, a constant is like a variable in that it is an identifier that holds a value, but, unlike variables, constants are not variable, they are constant. Good name choices, right?

Whereas variables are declared with the `let` keyword, constants are declared with the `const` keyword:

```
const NUM = 1;
```

Constants cannot be reassigned; that is, a later statement like `NUM = 2;` would fail, meaning that the value of `NUM` would remain 1; depending on how the browser you are using handles `const`, the later statement may either cause the code to fail or simply not assign the new value to `NUM`. In Google Chrome, for example, trying to assign a new value to a constant will cause an error. We can see this using the Chrome DevTools Console:

```
> const NUM = 1;
<- undefined
> NUM = 2;
✖ ▶ Uncaught TypeError: VM395:1
Assignment to constant
variable.
at <anonymous>:1:5
```

While constants can be declared with uppercase or lowercase names, the convention is to use all-uppercase names for constants in the global scope⁴⁸, so they are easily distinguishable from variables. Constants in the function scope are named using lowerCamelCase, just like variables.

Constants in this Course

In this course, we often write small bits of code in the global scope (i.e., not within curly braces) that would normally be locally scoped in real code. In these cases, we use lowerCamelCase for our constant names.

Evaluation
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12.6. Arrays

An array is a grouping of objects that can be accessed through subscripts. At its simplest, an array can be thought of as a list. In JavaScript, the first element of an array is considered to be at position zero (0), the second element at position one (1), and so on. Arrays are useful for storing related sets of data.⁴⁹

Arrays are declared using the new keyword and should be defined as constant:

```
const myArray = new Array();
```

It is also possible and very common to use the [] literal to declare a new Array object:

```
const myArray = [];
```

48. You will learn more about scope when we cover functions.

49. Unlike in some languages, values in JavaScript arrays do not all have to be of the same data type.

When constants are not constant

When you declare a constant, you create a pointer to a specific object. You may not change the pointer (i.e., you cannot assign a new value to a constant), but you can change the object that is assigned to the constant (e.g., the items in the array).

Values are assigned to arrays as follows:

```
myArray[0] = value1;  
myArray[1] = value2;  
myArray[2] = value3;
```

Arrays can be declared with initial values.

```
const myArray = new Array(value1, value2, value3);
```

Or, using the [] notation:

```
const myArray = [value1, value2, value3];
```

The following example is similar to the previous one, except that it prompts the user for four different colors and places each into the `colors` array. It then displays the values in the `colors` array in the buttons and assigns them to `document.body.style.backgroundColor` when the user clicks the buttons.

Demo 12.2: Variables Arrays Operators/Demos/arrays.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9.   //Pop up four prompts and create an array
10.  const colors = new Array();
11.  colors[0] = prompt("Choose a color.", "");
12.  colors[1] = prompt("Choose a color.", "");
13.  colors[2] = prompt("Choose a color.", "");
14.  colors[3] = prompt("Choose a color.", "");
15. </script>
16. <title>JavaScript Arrays</title>
17. </head>
18. <body>
19. <main>
20.   <button onclick="document.body.style.backgroundColor = colors[0];">
21.     <script>
22.       document.write(colors[0]);
23.     </script>
24.   </button>
25.   <button onclick="document.body.style.backgroundColor = colors[1];">
26.     <script>
27.       document.write(colors[1]);
28.     </script>
29.   </button>
30.   <button onclick="document.body.style.backgroundColor = colors[2];">
31.     <script>
32.       document.write(colors[2]);
33.     </script>
34.   </button>
35.   <button onclick="document.body.style.backgroundColor = colors[3];">
36.     <script>
37.       document.write(colors[3]);
38.     </script>
39.   </button>
40. </main>
41. </body>
42. </html>
```

As the page loads, an array called `colors` is declared.

```
| colors = new Array();
```

The next four lines populate the array with user-entered values.

```
colors[0] = prompt("Choose a color.", "");  
colors[1] = prompt("Choose a color.", "");  
colors[2] = prompt("Choose a color.", "");  
colors[3] = prompt("Choose a color.", "");
```

The body of the page contains a paragraph with four <button> tags, the text of which is dynamically created with values from the `colors` array.

Exercise 16: Working with Arrays

 15 to 25 minutes

In this exercise, you will practice working with arrays.

1. Open `VariablesArraysOperators/Exercises/arrays.html` for editing.
2. Below the comment, declare a `rockStars` array and populate it with four values entered by the user.
3. Add functionality to the buttons, so that alerts pop up with values from the array when the buttons are clicked.
4. Test your solution in a browser. It should work as follows:
 - A. As the page loads, you should get four alerts (the values should be blank by default):

This page says

Who is your favorite rock star?

Chuck Berry

This page says

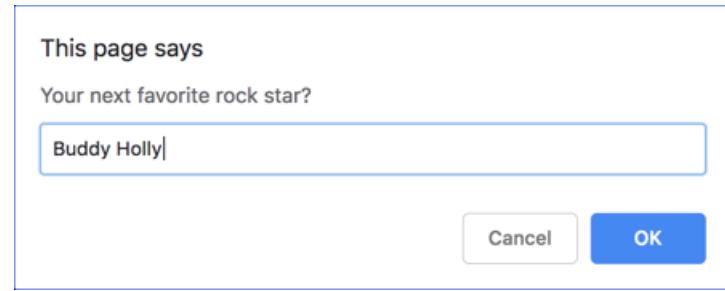
Your next favorite rock star?

Elvis

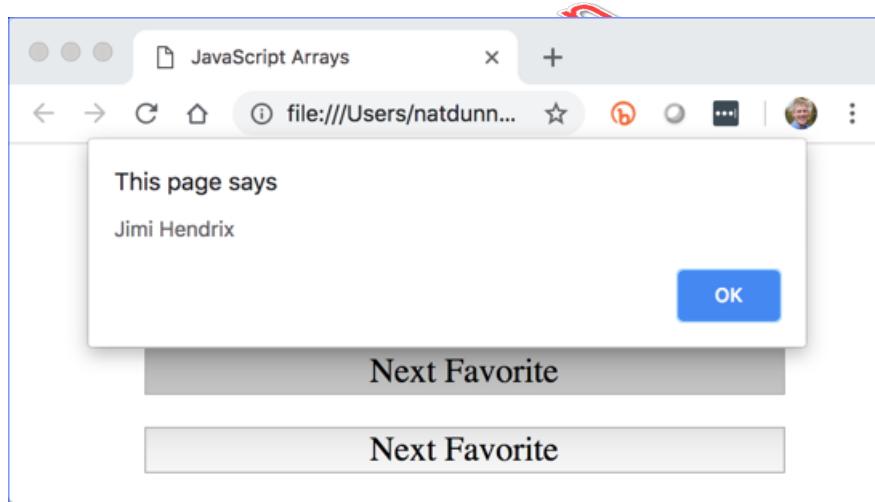
This page says

Your next favorite rock star?

Jimi Hendrix



- B. After responding to all the prompts, you should see four buttons on the page. When you click one of the buttons, it should alert one of your rock stars:



Exercise Code 16.1: VariablesArraysOperators/Exercises/arrays.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  /*
10.     Declare a rockStars array and populate it with
11.     four values entered by the user.
12. */
13. </script>
14. <title>JavaScript Arrays</title>
15. </head>
16. <body>
17. <main>
18.   <button>Favorite</button>
19.   <button>Next Favorite</button>
20.   <button>Next Favorite</button>
21.   <button>Next Favorite</button>
22. </main>
23. </body>
24. </html>
```

Evaluation
Copy

Solution: VariablesArraysOperators/Solutions/arrays.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const rockStars = new Array();
10.   rockStars[0] = prompt("Who is your favorite rock star?", "");
11.   rockStars[1] = prompt("Your next favorite rock star?", "");
12.   rockStars[2] = prompt("Your next favorite rock star?", "");
13.   rockStars[3] = prompt("Your next favorite rock star?", "");
14. </script>
15. <title>JavaScript Arrays</title>
16. </head>
17. <body>
18. <main>
19.   <button onclick="alert(rockStars[0]);">Favorite</button>
20.   <button onclick="alert(rockStars[1]);">Next Favorite</button>
21.   <button onclick="alert(rockStars[2]);">Next Favorite</button>
22.   <button onclick="alert(rockStars[3]);">Next Favorite</button>
23. </main>
24. </body>
25. </html>
```



12.7. Associative Arrays

Whereas regular (or enumerated) arrays are indexed numerically, associative arrays are indexed using names as keys. The advantage of this is that the keys can be meaningful, which can make it easier to reference an element in an array. The following code, written in Chrome DevTools Console, illustrates how an associative array is used:

```

> const beatles = [];
< undefined
> beatles["singer1"] = "Paul";
< "Paul"
> beatles["singer2"] = "John";
< "John"
> beatles["guitarist"] = "George";
< "George"
> beatles["drummer"] = "Ringo";
< "Ringo"
> beatles;
< ▶ [singer1: "Paul", singer2: "John", guitarist: "George", drummer: "Ringo"]
> beatles["drummer"];
< "Ringo"

```

Arrays can also have subarrays. For example, rather than having “singer1” and “singer2” keys, it would be better to have a “singers” key that was an enumerated array. We could do that like this:

```

> const beatles = [];
< undefined
> beatles["singers"] = ["Paul", "John"];
< ▶ (2) ["Paul", "John"]
> beatles["guitarist"] = "George";
< "George"
> beatles["drummer"] = "Ringo";
< "Ringo"
> beatles;
< ▶ [singers: Array(2), guitarist: "George", drummer: "Ringo"]
> beatles["singers"];
< ▶ (2) ["Paul", "John"]
> beatles["singers"][0];
< "Paul"
> beatles["singers"][1];
< "John"

```

Notice how the singers are accessed first by the “singers” key of the `beatles` array and then by the index:

```
beatles['singers'][0];
```

❖ 12.7.1. Array Properties and Methods

The tables below show some of the most useful array properties and methods. All of the examples assume an array called `beatles` that holds “Paul”, “John”, “George”, and “Ringo”.

```
const beatles = ["Paul", "John", "George", "Ringo"];
```

Array Properties

| Property | Description |
|----------|---|
| length | Holds the number of elements in an array. |
| | beatles.length // 4 |

Array Methods

| Property | Description |
|----------------------|---|
| join(delimiter) | Returns a delimited list of the items indexed with integers in the array. The default delimiter is a comma. beatles.join(":") // Paul:John:George:Ringo beatles.join() // Paul, John, George, Ringo |
| push() | Appends an element to an array. beatles.push("Steve") |
| pop() | Removes the last item in an array and returns its value. beatles.pop() // Returns Ringo |
| shift() | Removes the first item in an array and returns its value. beatles.shift() // Returns Paul |
| unshift() | Prepends one or more items to the beginning of an array. beatles.unshift('Paul') |
| slice(start, end) | Returns a subarray from start up to, but not including end. If end is left out, it includes the remainder of the array. beatles.slice(1, 3) //Returns [John, George] |
| splice(start, count) | Removes count items from start in the array and returns the resulting array. beatles.splice(1, 2) //Returns [Paul, Ringo] |
| sort() | Sorts an array alphabetically. beatles.sort() //Returns [George, John, Paul, Ringo] and sorts the array |



12.8. Playing with Array Methods

Take some time to play around with these array methods in Chrome DevTools Console. Try your own things and/or follow along with the following code.

```
> const beatles = ['Paul', 'John', 'George', 'Ringo'];
< undefined
> beatles.length;
< 4
> beatles.join(':');
< "Paul:John:George:Ringo"
> beatles.push('Steve');
< 5
> // Notice that beatles now contains Steve as the last element.
< undefined
> // Let's pop it off.
beatles.pop();
< "Steve"
> // Now we're back to the original beatles:
beatles;
< ▶ (4) ["Paul", "John", "George", "Ringo"]
> // shift() is like pop() but it returns and removes the first item:
beatles.shift();
< "Paul"
> // Now beatles will be missing Paul:
beatles;
< ▶ (3) ["John", "George", "Ringo"]
> // Let's use unshift to bring Paul back:
beatles.unshift('Paul');
< 4
> beatles;
< ▶ (4) ["Paul", "John", "George", "Ringo"]
```

Note that some methods will return a value without modifying the existing array, while others will make changes to the existing array “in place”. For example, study the following code. Notice that `slice()` returns a new array without changing the existing array, whereas `splice()` and `sort()` make changes to the existing array.

```

> beatles.slice(1,3); // Does not change existing array
< ▷ (2) ["John", "George"]
> beatles;
< ▷ (4) ["Paul", "John", "George", "Ringo"]
> beatles.splice(1,2); // Changes existing array
< ▷ (2) ["John", "George"]
> beatles;
< ▷ (2) ["Paul", "Ringo"]
> beatles = ['Paul','John','George','Ringo'];
< ▷ (4) ["Paul", "John", "George", "Ringo"]
> beatles.sort();
< ▷ (4) ["George", "John", "Paul", "Ringo"]
> beatles;
< ▷ (4) ["George", "John", "Paul", "Ringo"]

```

`slice()` returns a new array, but the original `beatles` array still contains all 4 names.

`splice()` returns a new array, and changes the original `beatles` array, removing two of the names.

`sort()` changes the array "in place," meaning it returns the same array after modifying it.

Array Documentation

See https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Array for full documentation on Arrays.



12.9. JavaScript Operators

Arithmetic Operators

| Operator | Description |
|----------|---------------------|
| + | Addition |
| - | Subtraction |
| * | Multiplication |
| / | Division |
| % | Modulus (remainder) |

Assignment Operators

| Operator | Description |
|----------|--|
| = | Assignment |
| += | One step addition and assignment ($a+=3$ is the same as $a=a+3$) |
| -= | One step subtraction and assignment ($a-=3$ is the same as $a=a-3$) |
| *= | One step multiplication and assignment ($a*=3$ is the same as $a=a*3$) |
| /= | One step division and assignment ($a/=3$ is the same as $a=a/3$) |
| %= | One step modulus and assignment ($a\%=3$ is the same as $a=a\%3$) |
| ++ | Increment by one ($a++$ is the same as $a=a+1$ or $a+=1$) |
| -- | Decrement by one ($a--$ is the same as $a=a-1$ or $a-=1$) |

String Operators

| Operator | Description |
|----------|---|
| + | Concatenation <pre>let greeting = "Hello " + firstname;</pre> |
| += | One step concatenation and assignment <pre>let greeting = "Hello "; greeting += firstname;</pre> |

The following code, written in Chrome DevTools Console, shows examples of working with JavaScript arithmetic operators:

```
> let a=5, b=4;
< undefined
> a+b;
< 9
> a-b;
< 1
> a*b;
< 20
> a/b;
< 1.25
> a%b; // Modulus returns remainder
< 1
> c=a++; // Assigns a to c and then increments a by 1
< 5
> c;
< 5
> a;
< 6
> d = a--; // Assigns a to d and then decrements a by 1
< 6
> d;
< 6
> a;
< 5
> a = a + 2; // Adds 2 to a
< 7
> a+=2; // Adds 2 to a
< 9
```

And here we have examples of the concatenation operator:

```
> let greeting = 'Hello';
< undefined
> let firstName = 'Nat';
< undefined
> greeting + ', ' + firstName; // Concatenation
< "Hello, Nat"
> let fullGreeting = greeting + ', ' + firstName;
< undefined
> fullGreeting;
< "Hello, Nat"
> fullGreeting += '!';
< "Hello, Nat!"
> fullGreeting;
< "Hello, Nat!"
```



12.10. The Modulus Operator

The *modulus* operator (%) is used to find the remainder after division:

```
5 % 2 // returns 1  
11 % 3 // returns 2  
22 % 4 // returns 2  
22 % 3 // returns 1  
10934 % 324 // returns 242
```

The modulus operator is useful for determining whether a number is even or odd:

```
1 % 2 // returns 1: odd  
2 % 2 // returns 0: even  
3 % 2 // returns 1: odd  
4 % 2 // returns 0: even  
5 % 2 // returns 1: odd  
6 % 2 // returns 0: even
```

Evaluation
Copy

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12.11. Playing with Operators

Take some time to play around with JavaScript operators in Chrome DevTools Console. Try your own things and/or follow along with the code in the preceding sections.

The file below illustrates the use of the concatenation operator and several math operators. It also illustrates a potential problem with loosely typed languages.

Demo 12.3: Variables Arrays Operators/Demos/operators.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const userNum1 = window.prompt("Choose a number.", "");
10.   alert("You chose " + userNum1);
11.   const userNum2 = window.prompt("Choose another number.", "");
12.   alert("You chose " + userNum2);
13.   const numsAdded = userNum1 + userNum2;
14.   const numsSubtracted = userNum1 - userNum2;
15.   const numsMultiplied = userNum1 * userNum2;
16.   const numsDivided = userNum1 / userNum2;
17.   const numsModulused = userNum1 % userNum2;
18. </script>
19. <title>JavaScript Operators</title>
20. </head>
21. <body>
22. <main>
23.   <p>
24.     <script>
25.       document.write(userNum1 + " + " + userNum2 + " = ");
26.       document.write(numsAdded + "<br>");
27.       document.write(userNum1 + " - " + userNum2 + " = ");
28.       document.write(numsSubtracted + "<br>");
29.       document.write(userNum1 + " * " + userNum2 + " = ");
30.       document.write(numsMultiplied + "<br>");
31.       document.write(userNum1 + " / " + userNum2 + " = ");
32.       document.write(numsDivided + "<br>");
33.       document.write(userNum1 + " % " + userNum2 + " = ");
34.       document.write(numsModulused + "<br>");
35.     </script>
36.   </p>
37. </main>
38. </body>
39. </html>
```

Evaluation
Copy

This page is processed as follows:

1. The user is prompted for a number and the result is assigned to userNum1:

This page says

Choose a number.

Cancel OK

2. An alert pops up telling the user what number they entered. The concatenation operator (+) is used to combine two strings: "You chose " and the number entered by the user. Note that all user-entered data is always treated as a string of text, even if the text consists of only digits:

This page says

You chose 5

OK

3. The user is prompted for another number and the result is assigned to `userNum2`:

This page says

Choose another number.

Cancel OK

4. Another alert pops up telling the user what number they entered:

This page says

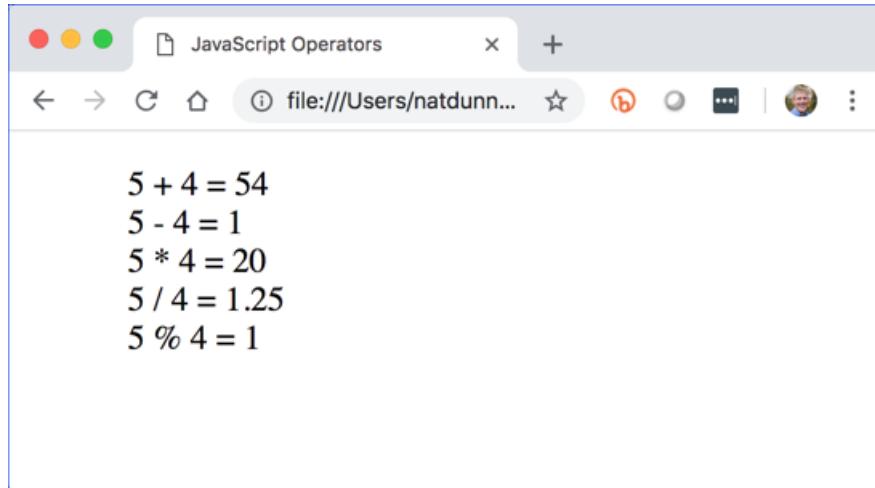
You chose 4

OK

5. Five constants are declared and assigned values :

```
const numsAdded = userNum1 + userNum2;
const numsSubtracted = userNum1 - userNum2;
const numsMultiplied = userNum1 * userNum2;
const numsDivided = userNum1 / userNum2;
const numsModulused = userNum1 % userNum2;
```

6. The values the constants contain are output to the browser:



So, $5 + 4$ is 54 ? Well, only if 5 and 4 are strings, and, as stated earlier, all user-entered data is treated as a string. Don't worry. We will learn how to fix this problem soon.



12.12. The Default Operator

Default Operator

| Operator | Description |
|----------|---|
| | Used to assign a default value. const yourName = prompt("Your Name?", "") "Stranger"; |

The following code sample shows how the default operator works:

Demo 12.4: Variables Arrays Operators/Demos/default.html

```
-----Lines 1 through 7 Omitted-----  
8. <script>  
9.   const yourName = prompt("Your Name?", "") || "Stranger";  
10.  
11.  alert("Hi " + yourName + "!");  
12. </script>  
-----Lines 13 through 20 Omitted-----
```

If the user presses **OK** without filling out the prompt or presses **Cancel**, the default value “Stranger” is assigned to the `yourName` constant.

Why do we need a default operator?

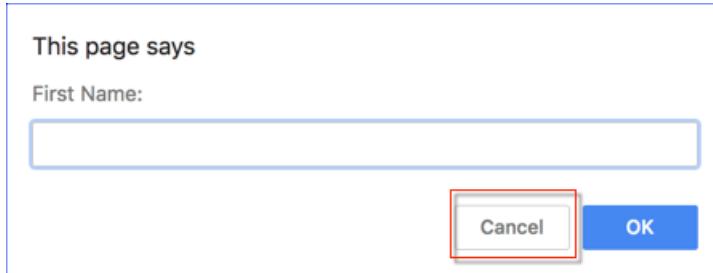
The default operator allows you to make sure that your variable contains a non-null value, so that you can perform operations on the variable with no errors. To illustrate, do the following in the Chrome DevTools Console:

1. Enter the following code and press **Enter**:

```
let firstName = prompt("First Name:", "");
```

This will cause a prompt to pop up.

2. Press the **Cancel** button. This will return `null` and assign it to `firstName`:



3. Enter the following code and press **Enter**:

```
let greeting = "Hello, " + firstName;
```

4. Then output `greeting` and you'll see this strange result:

```
> let firstName = prompt("First name:", "");  
< undefined  
> let greeting = "Hello, " + firstName;  
< undefined  
> greeting;  
< "Hello, null"
```

Now repeat the above, but start with:

```
let firstName = prompt("First Name:", "") || "Stranger";
```

This time, when you press **Cancel**, the default value of “Stranger” will be assigned to `firstName` and the concatenation operation will work fine:

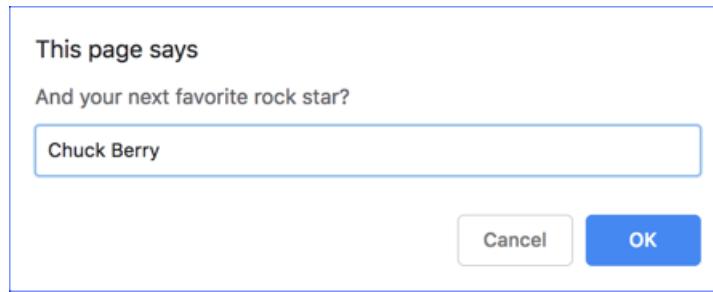
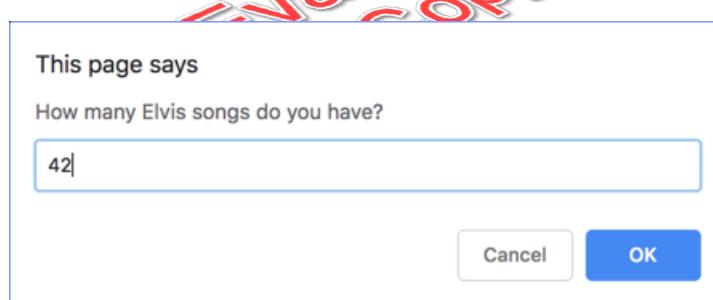
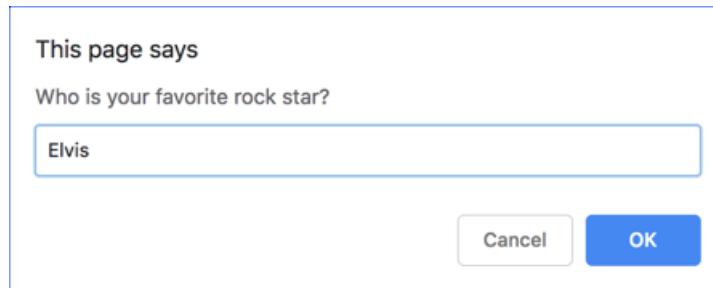
```
> let firstName = prompt("First name:", "") || "Stranger";  
< undefined  
> let greeting = "Hello, " + firstName;  
< undefined  
> greeting;  
< "Hello, Stranger"
```

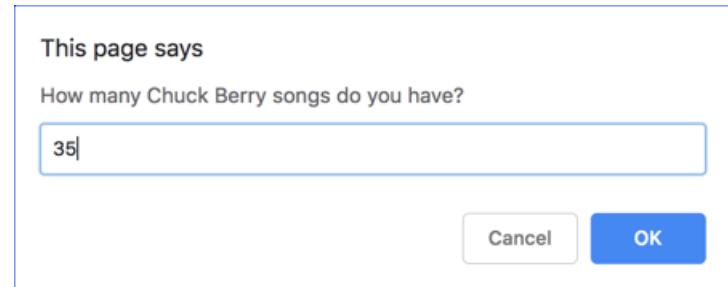
Exercise 17: Working with Operators

 15 to 25 minutes

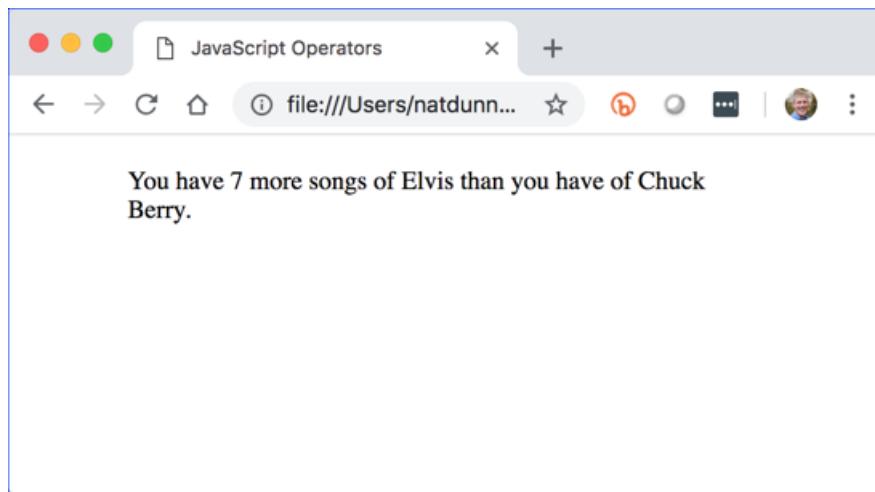
In this exercise, you will practice working with JavaScript operators.

1. Open `VariablesArraysOperators/Exercises/operators.html` for editing.
2. Add code to prompt the user for the number of songs they have downloaded of their favorite and second favorite rock stars:





3. In the body, let the user know how many more of their favorite rock star's songs they have than of their second favorite rock star's songs:



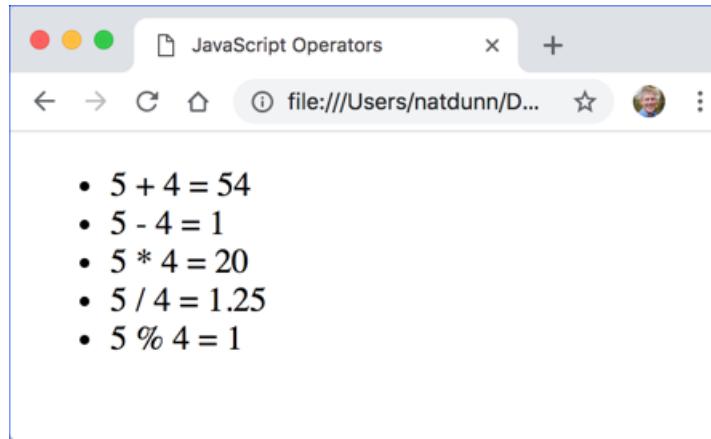
4. Test your solution in a browser.

Exercise Code 17.1: VariablesArraysOperators/Exercises/operators.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const rockStars = [];
10.   rockStars[0] = prompt("Who is your favorite rock star?", "");
11.   /*
12.     Ask the user how many of this rockstar's songs they have downloaded
13.     and store the result in a variable.
14.   */
15.   rockStars[1] = prompt("And your next favorite rock star?", "");
16.   /*
17.     Ask the user how many of this rockstar's songs they have downloaded
18.     and store the result in a variable.
19.   */
20.  </script>
21.  <title>JavaScript Operators</title>
22.  </head>
23.  <body>
24.  <main>
25.  <!--
26.    Let the user know how many more of their favorite rock star's songs
27.    they have than of their second favorite rock star's songs.
28.  -->
29.  </main>
30.  </body>
31.  </html>
```

Challenge

1. Open `VariablesArraysOperators/Exercises/operators-challenge.html` for editing.
2. Modify it so that it outputs an unordered list as shown below:



Don't worry about the 54 . We will learn how to fix the addition problem soon.

Solution: VariablesArraysOperators/Solutions/operators.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const rockStars = [];
10.   const songTotals = [];
11.   rockStars[0] = prompt("Who is your favorite rock star?", "");
12.   songTotals[0] = prompt("How many " + rockStars[0] +
13.                           " songs do you have?", "");
14.   rockStars[1] = prompt("And your next favorite rock star?", "");
15.   songTotals[1] = prompt("How many " + rockStars[1] +
16.                           " songs do you have?", "");
17. </script>
18. <title>JavaScript Operators</title>
19. </head>
20. <body>
21. <main>
22.   <script>
23.     const diff = songTotals[0] - songTotals[1];
24.     document.write("You have " + diff + " more songs of " + rockStars[0]);
25.     document.write(" than you have of " + rockStars[1] + ".");
26.   </script>
27. </main>
28. </body>
29. </html>
```

Challenge Solution:

VariablesArraysOperators/Solutions/operators-challenge.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const userNum1 = prompt("Choose a number.", "");
10.   alert("You chose " + userNum1);
11.   const userNum2 = prompt("Choose another number.", "");
12.   alert("You chose " + userNum2);
13.   const numsAdded = userNum1 + userNum2;
14.   const numsSubtracted = userNum1 - userNum2;
15.   const numsMultiplied = userNum1 * userNum2;
16.   const numsDivided = userNum1 / userNum2;
17.   const numsModulused = userNum1 % userNum2;
18. </script>
19. <title>JavaScript Operators</title>
20. </head>
21. <body>
22. <main>
23. <ul>
24.   <script>
25.     document.write("<li>" + userNum1 + " + " + userNum2 + " = ");
26.     document.write(numsAdded + "</li>");
27.     document.write("<li>" + userNum1 + " - " + userNum2 + " = ");
28.     document.write(numsSubtracted + "</li>");
29.     document.write("<li>" + userNum1 + " * " + userNum2 + " = ");
30.     document.write(numsMultiplied + "</li>");
31.     document.write("<li>" + userNum1 + " / " + userNum2 + " = ");
32.     document.write(numsDivided + "</li>");
33.     document.write("<li>" + userNum1 + " % " + userNum2 + " = ");
34.     document.write(numsModulused + "</li>");
35.   </script>
36. </ul>
37. </main>
38. </body>
39. </html>
```



Conclusion

In this lesson, you have learned to work with JavaScript variables, arrays and operators.

Evaluation
Copy

LESSON 13

JavaScript Functions

Topics Covered

- JavaScript's global functions and objects.
- Creating your own functions.
- Returning values from functions.

Introduction

In this lesson, you will learn to use some of JavaScript's built-in-functions, and you will also learn to create your own.



13.1. Global Objects and Functions

A “global” function or object is one that is accessible from anywhere. JavaScript has a number of global objects and functions. We will examine some of them in this section.

❖ 13.1.1. `parseFloat(object)`

The `parseFloat()` function takes one argument: an object, and attempts to return a floating point number, which is a decimal number. If it cannot, it returns `NaN`, for “Not a Number.”

Remember when we “add” two strings using the plus sign (+), the strings are concatenated together, as the following code illustrates:

```
const strNum1 = '1';
const strNum2 = '2';
const strSum = strNum1 + strNum2;
strSum; // will return "12"
```

Because `strNum1` and `strNum2` are both strings, the + operator concatenates them, resulting in “12”.

We can use `parseFloat()` to convert those strings to numbers before adding them:

```
const strNum1 = '1';
const strNum2 = '2';
const num1 = parseFloat(strNum1);
const num2 = parseFloat(strNum2);
const sum = num1 + num2;
sum; // will return 3
```

After the `parseFloat()` function has been used to convert the strings to numbers, the `+` operator performs addition, resulting in 3.

If the value passed to `parseFloat()` doesn't start with a number, the function returns `Nan`:

```
parseFloat('I want 1.5 apples'); // will return NaN
```

❖ 13.1.2. `parseInt(object)`

The `parseInt()` function is similar to `parseFloat()`. It takes one argument: an object, and attempts to return an integer. If it cannot, it returns `NaN`, for “Not a Number.”

As you can see from the following code, `parseInt()` just strips everything to the right of the first integer it finds. If the value passed to `parseInt()` doesn't start with an integer, the function returns `NaN`:

```
parseInt('1'); // will return 1
parseInt('1.5'); // will return 1
parseInt('1.5 apples'); // will return 1
parseInt('I want 1.5 apples'); // will return NaN
```

❖ 13.1.3. `isNaN(object)`

The `isNaN()` function takes one argument: an object. The function checks if the object is *not* a number (or cannot be converted to a number). It returns `true` if the object is not a number and `false` if it is a number:

```
isNaN(4); // will return false  
isNaN('4'); // will return false  
isNaN('hello'); // will return true
```

As you can see from the code above, if the passed-in value is a number or can be converted into a number (e.g., 4 and '4'), `isNaN()` returns `false`. Otherwise (e.g., 'hello'), it returns `true`, meaning that it **is** indeed Not a Number.

Exercise 18: Working with Global Functions

 10 to 15 minutes

In this exercise, you will practice working with JavaScript's global functions.

1. Open `JavaScriptFunctions/Exercises/built-in-functions.html` for editing.
2. As the code is currently written (see below), it will concatenate the user-entered numbers rather than add them. Fix this so that it outputs the sum of the two numbers entered by the user.

Exercise Code 18.1: JavaScriptFunctions/Exercises/built-in-functions.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    let userNum1;
10.   let userNum2;
11.   let numsAdded;
12.   userNum1 = window.prompt("Choose a number.", "");
13.   alert("You chose " + userNum1);
14.   userNum2 = window.prompt("Choose another number.", "");
15.   alert("You chose " + userNum2);
16.   numsAdded = userNum1 + userNum2;
17. </script>
18. <title>JavaScript Built-in Functions</title>
19. </head>
20. <body>
21. <p>
22.   <script>
23.     document.write(userNum1 + " + " + userNum2 + " = ");
24.     document.write(numsAdded);
25.   </script>
26. </p>
27. </body>
28. </html>
```

Challenge

Create a new HTML file that prompts the user for

1. Their name:

This page says

What's your name?

The age at which they first worked on a computer:

This page says

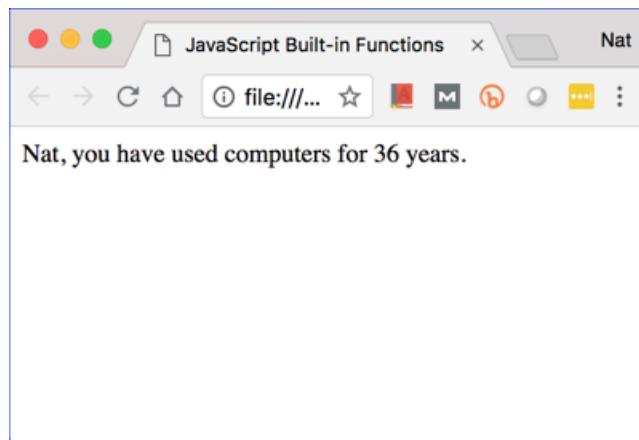
How old were you when you first used a computer?

And their current age:

This page says

How old are you now?

After gathering this information, write out to the page how many years they have been working on a computer:

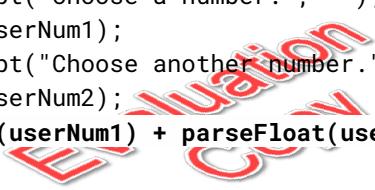


Notice that the program is able to deal with numbers followed by strings (e.g., “12 years old”).

values of
variables

Solution: JavaScriptFunctions/Solutions/built-in-functions.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    let userNum1;
10.   let userNum2;
11.   let numsAdded;
12.   userNum1 = window.prompt("Choose a number.", "");
13.   alert("You chose " + userNum1);
14.   userNum2 = window.prompt("Choose another number.", "");
15.   alert("You chose " + userNum2);
16.   numsAdded = parseFloat(userNum1) + parseFloat(userNum2);
17. </script>
18. <title>JavaScript Built-in Functions</title>
19. </head>
20. <body>
21. <main>
22.   <p>
23.     <script>
24.       document.write(userNum1 + " + " + userNum2 + " = ");
25.       document.write(numsAdded);
26.     </script>
27.   </p>
28. </main>
29. </body>
30. </html>
```



Challenge Solution: JavaScriptFunctions/Solutions/built-in-functions-challenge.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const userName = prompt("What's your name?");
10.   const age1 = prompt('How old were you when you first used a computer?');
11.   const age2 = prompt('How old are you now?');
12.   const diff = parseFloat(age2) - parseFloat(age1);
13. </script>
14. <title>JavaScript Built-in Functions</title>
15. </head>
16. <body>
17. <main>
18.   <p>
19.     <script>
20.       document.write(userName + ', you have used '
21.                     +'computers for ' + diff + ' years.');
22.     </script>
23.   </p>
24. </main>
25. </body>
26. </html>
```

Evolution
Code

Code Explanation

You may have noticed that we are not including the second argument, which is the default value, for `prompt()` in the challenge solution. While these could be written as `const age2 = prompt("How old are you now?", "");`, this is not necessary as an empty string is the default value.

*

13.2. User-defined Functions

Writing functions makes it possible to reuse code for common tasks. Functions can also be used to hide complex code. For example, an experienced developer can write a function for performing a

complicated task. Other developers do not need to know how that function works; they only need to know how to call it.

❖ 13.2.1. Function Syntax

JavaScript functions generally appear in the head of the page or in external JavaScript files. A function is written using the `function` keyword followed by the name of the function.

```
function doSomething() {  
    //function statements go here  
}
```

As you can see, the body of the function is contained within curly brackets (`{ }`). The following example demonstrates the use of simple functions:

Demo 13.1: JavaScriptFunctions/Demos/simple-functions.html

```
1.  <!DOCTYPE html>  
2.  <html lang="en">  
3.  <head>  
4.  <meta charset="UTF-8">  
5.  <meta name="viewport" content="width=device-width,initial-scale=1">  
6.  <link rel="stylesheet" href="../../normalize.css">  
7.  <link rel="stylesheet" href="../../styles.css">  
8.  <script>  
9.      function changeBgRed() {  
10.          document.body.style.backgroundColor = "red";  
11.      }  
12.  
13.      function changeBgWhite() {  
14.          document.body.style.backgroundColor = "white";  
15.      }  
16.  </script>  
17.  <title>JavaScript Simple Functions</title>  
18.  </head>  
19.  <body>  
20.      <button onclick="changeBgRed();">Red</button>  
21.      <button onclick="changeBgWhite();">White</button>  
22.  </body>  
23.  </html>
```

When the user clicks one of the buttons, the event is captured by the `onclick` event handler and the corresponding function is called.

❖ 13.2.2. Passing Values to Functions

The functions above aren't very useful because they always do the same thing. Every time we wanted to add another color, we would have to write another function. Also, if we want to modify the behavior, we will have to do it in each function. The following example shows how to create a single function to handle changing the background color.

Demo 13.2: JavaScriptFunctions/Demos/passing-values.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      function changeBg(color) {
10.          document.body.style.backgroundColor = color;
11.      }
12.  </script>
13.  <title>Passing Values</title>
14.  </head>
15.  <body>
16.      <button onclick="changeBg('red');">Red</button>
17.      <button onclick="changeBg('white');">White</button>
18.  </body>
19. </html>
```

Evaluation
Copy

As you can see, when calling the `changeBg()` function, we pass a value (e.g., `'red'`), which is assigned to the `color` variable. We can then refer to the `color` variable throughout the function. Variables created in this way are called “parameters” and the values passed to them are called “arguments”. A function can have any number of parameters, separated by commas.

Adding parameters to functions makes them more flexible and, thus, more useful; as you saw above, we can call the `changeBg()` function many times, passing to it a different color as needed. We can make our functions even more useful by providing default values for parameters so that, if the function is called without an argument, we assign some default value to the parameter. Here's how we might modify our earlier example:

Demo 13.3:

JavaScriptFunctions/Demos/passing-values-default-param.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      function changeBg(color='blue') {
10.          document.body.style.backgroundColor = color;
11.      }
12.  </script>
13.  <title>Passing Values - Default Param</title>
14.  </head>
15.  <body>
16.  <p>
17.      <button onclick="changeBg('red');">Red</button>
18.      <button onclick="changeBg('white');">White</button>
19.      <button onclick="changeBg();">Blue (no param)</button>
20.  </p>
21.  </body>
22. </html>
```

Evaluation
Copy

We've added a default value for `changeBg`'s `color` parameter, giving it the value '`blue`' if no value is supplied when the function is called. We've also added a third button on which the user can click; here we call `changeBg()` (without a parameter for `color`) and thus get the default color '`blue`'.

A Note on Variable Scope

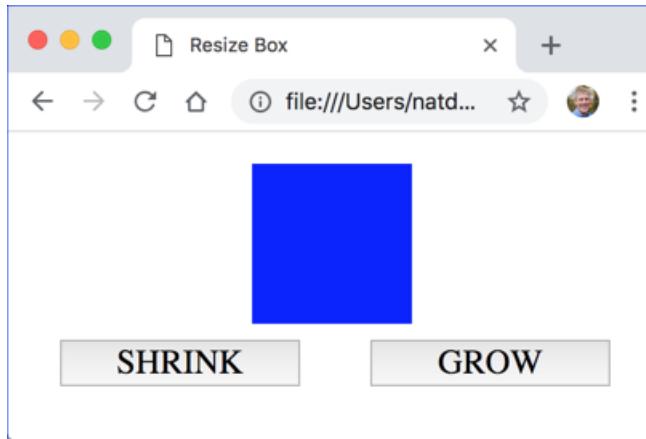
A variable's "scope" is the context in which the variable can be referenced. Variables created by passing arguments to function parameters are local to the function, meaning that they cannot be accessed outside of the function. The same is true for variables declared within a function using the `let` keyword.

Variables declared with `let` outside of a function can only be used in the block of code in which the variable is defined.

Exercise 19: Writing a JavaScript Function

 15 to 25 minutes

In this exercise, you will modify a page called `resize-box.html`, which will contain a box and two buttons for resizing the box:



1. Open `JavaScriptFunctions/Exercises/resize-box.html` for editing.
2. Notice that the page has a `div` with the id "box" and `width` and `height` styles set.
3. The page also contains two buttons that call `resizeBox()` passing in `-10` and `10` for the `change` argument.
4. Write a function called `resizeBox()` that has one parameter: `change`, which is the amount the width and height of the box should be changed. The default value of `change` should be `10`. The `resizeBox()` function will need to do the following:

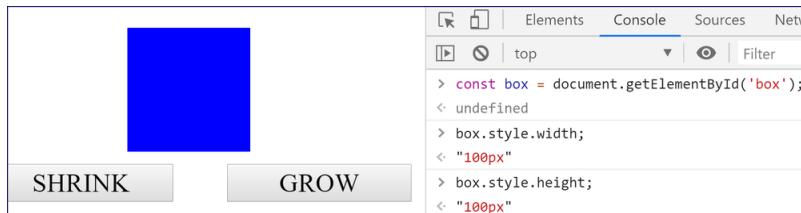
- A. Declare a constant `box` that holds the "box" `div`. You will do this using `document.getElementById()`, which is a method for accessing elements on the page by their `id` value:

```
const box = document.getElementById('box');
```

- B. Declare a constant `w` that holds the current width of the box. You will do this with the following line of code:

```
const w = box.style.width;
```

Note that the value will be a string ending in “px” as shown below. This is because `width` and `height` style values take a number and a unit.



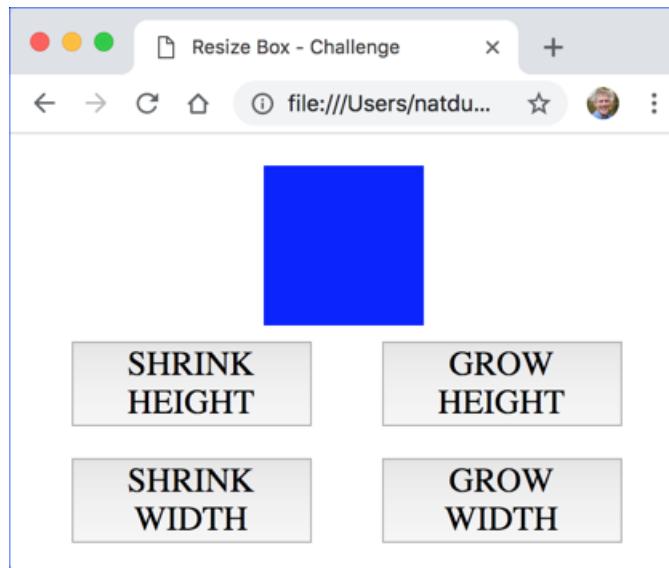
- C. Just as you did for `width`, declare a constant `h` that holds the current height of the box.
- D. Declare variables `wNew` and `hNew` that contain the new `width` and `height` values. Note that you will need to add the value of `change` to the current values of `w` and `h`, but before doing so, you will need to strip off the “px” from `w` and `h` and convert those values to numbers. You can do that with `parseInt()`.
- E. Assign the new values of `w` and `h` to `box.style.width` and `box.style.height`. Note that you will need to append (concatenate) “px” back to those values.

Exercise Code 19.1: JavaScriptFunctions/Exercises/resize-box.html

1. `<!DOCTYPE html>`
2. `<html lang="en">`
3. `<head>`
4. `<meta charset="UTF-8">`
5. `<meta name="viewport" content="width=device-width, initial-scale=1">`
6. `<link rel="stylesheet" href="../normalize.css">`
7. `<link rel="stylesheet" href="../styles.css">`
8. `<script>`
9. `// Write your code here`
10. `</script>`
11. `<title>Resize Box</title>`
12. `</head>`
13. `<body id="resize-box">`
14. `<main>`
15. `<div id="box" style="width:100px; height:100px;`
16. `background-color:blue;"></div>`
17. `<button onclick="resizeBox(-10)">SHRINK</button>`
18. `<button onclick="resizeBox(10)">GROW</button>`
19. `</main>`
20. `</body>`
21. `</html>`

Challenge

Add separate buttons for changing height and width:



As we haven't learned to write conditional code yet, you will need to write separate functions; for example, `resizeBoxHeight()` and `resizeBoxWidth()`.

Solution: JavaScriptFunctions/Solutions/resize-box.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  function resizeBox(change=10) {
10.    const box = document.getElementById('box');
11.    const w = box.style.width;
12.    const h = box.style.height;
13.    const wNew = parseInt(w) + change;
14.    const hNew = parseInt(h) + change;
15.    box.style.width = wNew + 'px';
16.    box.style.height = hNew + 'px';
17.  }
18. </script>
19. <title>Resize Box</title>
20. </head>
21. <body id="resize-box">
22. <main>
23.   <div id="box" style="width:100px; height:100px;"></div>
24.   <button onclick="resizeBox(-10)">SHRINK</button>
25.   <button onclick="resizeBox(10)">GROW</button>
26. </main>
27. </body>
28. </html>
```

Challenge Solution: JavaScriptFunctions/Solutions/resize-box-challenge.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  function resizeHeight(change=10) {
10.    const box = document.getElementById('box');
11.    const h = box.style.height;
12.    const hNew = parseInt(h) + change;
13.    box.style.height = hNew + 'px';
14.  }
15.
16. function resizeWidth(change=10) {
17.   const box = document.getElementById('box');
18.   const w = box.style.width;
19.   const wNew = parseInt(w) + change;
20.   box.style.width = wNew + 'px';
21. }
22. </script>
23. <title>Resize Box - Challenge</title>
24. </head>
25. <body id="resize-box">
26. <main>
27.   <div id="box" style="width:100px; height:100px;"></div>
28.   <button onclick="resizeHeight(-10)">SHRINK HEIGHT</button>
29.   <button onclick="resizeHeight(10)">GROW HEIGHT</button><br>
30.   <button onclick="resizeWidth(-10)">SHRINK WIDTH</button>
31.   <button onclick="resizeWidth(10)">GROW WIDTH</button>
32. </main>
33. </body>
34. </html>
```

Evaluation
Copy

13.3. Returning Values from Functions

The `return` keyword is used to return values from functions as the following example illustrates:

Demo 13.4: JavaScriptFunctions/Demos/return-value.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  function setBgColor() {
10.    const bg = prompt("Set Background Color:", "");
11.    document.body.style.backgroundColor = bg;
12. }
13.
14. function getBgColor() {
15.   return document.body.style.backgroundColor;
16. }
17. </script>
18. <title>Returning a Value</title>
19. </head>
20. <body>
21.   <button onclick="setBgColor()">Set Background Color</button>
22.   <button onclick="alert(getBgColor())">Get Background Color</button>
23. </body>
24. </html>
```

Evaluation
Copy

When the user clicks the “Get Background Color” button, an alert pops up with a value returned from the `getBgColor()` function. This is a very simple example. Generally, functions that return values are a bit more involved. We’ll see many more functions that return values throughout the course.

Conclusion

In this lesson, you have learned to work with JavaScript’s global functions and to create functions of your own.

LESSON 14

Built-In JavaScript Objects

Topics Covered

- Built-in String object.
- Built-in Math object.
- Built-in Date object.

Introduction

JavaScript has some predefined, built-in objects that enable you to work with Strings and Dates, and perform mathematical operations.

14.1. String

Evaluation
Copy

In JavaScript, there are two types of string data types: primitive strings and *String* objects. *String* objects have many methods for manipulating and parsing strings of text. Because these methods are available to primitive strings as well, in practice, there is no need to differentiate between the two types of strings.

Some common string properties and methods are shown below. In all the examples, the constant `myStr` contains “Webucator”:

```
const myStr = 'Webucator';
```

Common String Properties

| Property | Description |
|---------------------|---|
| <code>length</code> | Read-only value containing the number of characters in the string. <code>myStr.length; // returns 9</code> |

Try the following out in the Chrome DevTools Console:

```
const myStr = 'Webucator';
myStr.length; // will return 9
```

Spend some time going through methods in the table below and trying them out in the Chrome DevTools Console. Note that most programming languages have similar string methods, though they may use different names. Some of the string methods will seem obscure (“When would I use that?”). Don’t worry too much about that. The most important takeaway is to understand that there are a lot of built-in methods for working with strings and to get some practice using them.

Common String Methods

| Method | Description |
|-----------------------------|--|
| charAt(position) | Returns the character at the specified position. <code>myStr.charAt(4); // returns 'c'</code> <code>myStr.charAt(0); // returns 'W'</code> |
| indexOf(substr, startPos) | Searches from <code>startPos</code> (or the beginning of the string, if <code>startPos</code> is not supplied) for <code>substr</code> . Returns the first position at which <code>substr</code> is found or -1 if <code>substr</code> is not found. <code>myStr.indexOf("cat"); // returns 4</code> <code>myStr.indexOf("cat", 5); // returns -1</code> |
| lastIndexOf(substr, endPos) | Searches from <code>endPos</code> (or the end of the string, if <code>endPos</code> is not supplied) for <code>substr</code> . Returns the last position at which <code>substr</code> is found or -1 if <code>substr</code> is not found. <code>myStr.lastIndexOf("cat"); // returns 4</code> <code>myStr.lastIndexOf("cat", 5); // returns 4</code> |
| substring(startPos, endPos) | Returns the substring beginning at <code>startPos</code> and ending with the character before <code>endPos</code> . <code>endPos</code> is optional. If it is excluded, the substring continues to the end of the string. <code>myStr.substring(4, 7); // returns cat</code> <code>myStr.substring(4); // returns cator</code> |
| slice(startPos, endPos) | Same as <code>substring(startPos, endPos)</code> . <code>myStr.slice(4, 7); // returns cat</code> |
| slice(startPos, posFromEnd) | <code>posFromEnd</code> is a negative integer. Returns the substring beginning at <code>startPos</code> and ending <code>posFromEnd</code> characters from the end of the string. <code>myStr.slice(4, -2); // returns cat</code> |
| split(delimiter) | Returns an array by splitting a string on the specified delimiter. <code>const s = "A,B,C,D";</code> <code>const a = s.split(",");</code> <code>document.write(a[2]); // returns C</code> |

| Method | Description |
|---------------|---|
| toLowerCase() | Returns the string in all lowercase letters. myStr.toLowerCase(); // returns webucator |
| toUpperCase() | Returns the string in all uppercase letters. myStr.toUpperCase(); // returns WEBUCATOR |
| trim() | Removes leading and trailing whitespace. ' Webucator '.trim(); // returns Webucator with no spaces around it |

Below are the same methods from the table above shown in the Chrome DevTools Console:

```
> const myStr = 'Webucator';
< undefined
> myStr.charAt(4);
< "c"
> myStr.indexOf('cat');
< 4
> myStr.indexOf('dog'); // Returns -1 (not found)
< -1
> myStr.lastIndexOf('cat');
< 4
> 'banana'.indexOf('an'); // First occurrence of 'an'
< 1
> 'banana'.lastIndexOf('an'); // Last occurrence of 'an'
< 3
> myStr.substring(4,7);
< "cat"
> myStr.substring(4);
< "cator"
> myStr.slice(4,7);
< "cat"
> myStr.slice(4,-2);
< "cat"
> myStr.toLowerCase();
< "webucator"
> myStr.toUpperCase();
< "WEBUCATOR"
> ' webucator '.trim();
< "webucator"
```

Splitting a String

The `split()` method returns an array by splitting a string on the specified delimiter (separator). The following code illustrates this:

```
const s = "A,B,C,D";
const a = s.split(",");
a[2]; // returns C
```

Try it out in the Chrome DevTools Console:

```
> const s = 'A,B,C,D';
< undefined
> const a = s.split(',');
< undefined
> a;
< ▶ (4) [ "A", "B", "C", "D" ] ⓘ
  0: "A"
  1: "B"
  2: "C"
  3: "D"
  length: 4
  ► __proto__: Array(0)
> a[2];
< "C"
```

Converting an Object to a String

To convert an object to a string, pass it to `String()`. For example:

```
> let i = 10;
< undefined
> typeof i;
< "number"
> i = String(i);
< "10"
> typeof i;
< "string"
```

String Documentation

See https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/String for full documentation on Strings.



14.2. Math

The `Math` object's properties and methods are accessed directly (e.g., `Math.PI`) and are used for performing complex math operations. Some common math properties and methods are shown below:

Common Math Properties

| Property | Description |
|-------------------------|--|
| <code>Math.PI</code> | The value of Pi (π) <code>Math.PI; //3.141592653589793</code> |
| <code>Math.SQRT2</code> | Square root of 2. <code>Math.SQRT2; //1.4142135623730951</code> |

Try the following out in the Chrome DevTools Console:

```
> Math.PI;  
< 3.141592653589793  
> Math.SQRT2;  
< 1.4142135623730951
```

Spend some time going through methods in the table below and trying them out in the Chrome DevTools Console.

Common Math Methods

| Method | Description |
|-------------------------|---|
| Math.abs(number) | Absolute value of number. Math.abs(-12); // returns 12 |
| Math.ceil(number) | number rounded up. Math.ceil(5.4); // returns 6 |
| Math.floor(number) | number rounded down. Math.floor(5.6); // returns 5 |
| Math.max(numbers) | Highest Number in numbers. Math.max(2, 5, 9, 3); // returns 9 |
| Math.min(numbers) | Lowest Number in numbers. Math.min(2, 5, 9, 3); // returns 2 |
| Math.pow(number, power) | number to the power of power. Math.pow(2, 5); // returns 32 |
| Math.round(number) | Rounded number. Math.round(2.5); // returns 3 |
| Math.random() | Random number between 0 and 1. Math.random(); // Returns random number from 0 to 1 |

Below are the same methods from the table above shown in the Chrome DevTools Console:

```
> Math.abs(-12);
<- 12
> Math.ceil(5.4);
<- 6
> Math.floor(5.6);
<- 5
> Math.max(2,5,9,3);
<- 9
> Math.min(2,5,9,3);
<- 2
> Math.pow(2,5);
<- 32
> Math.round(2.5);
<- 3
> Math.random();
<- 0.7473928751077172
```

Method for Generating Random Integers

Because `Math.random()` returns a decimal value greater than or equal to 0 and less than 1, we can use the following code to return a random integer between `low` and `high`, inclusively (meaning the low and high values are included):

```
function randInt(low, high) {
  const rndDec = Math.random();
  const rndInt = Math.floor(rndDec * (high - low + 1) + low);
  return rndInt;
}
```

And here it is in the Chrome DevTools Console:

```
> function randInt(low, high) {
  const rndDec = Math.random();
  const rndInt = Math.floor(rndDec * (high - low + 1) + low);
  return rndInt;
}
< undefined
> randInt(1, 10);
< 6
> randInt(1, 100);
< 77
```

Math Documentation

See <https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Globals/Math> for full documentation on Math.

14.3. Date

*
**Evaluation
Copy**

The Date object has methods for manipulating dates and times. JavaScript stores dates as the number of milliseconds since January 1, 1970.

The Epoch

The **epoch** is the moment that a computer or computer language considers time to have started. JavaScript considers the epoch to be January 1, 1970 at midnight (1970-01-01 00:00:00)

The following code samples show the different methods of creating date objects, all of which involve passing arguments to the `Date()` *constructor* (a special function for creating objects):

New Date object with current date and time

```
const now = new Date();
now; // returns Thu Nov 11, 2021 18:40:31 GMT-0500 (Eastern Standard Time)
```

New Date object with specific date and time

```
// Syntax: new Date('month dd, yyyy hh:mm:ss')
const moonLanding = new Date('July 21, 1969 16:18:00');
moonLanding; // returns Mon Jul 21, 1969 16:18:00 GMT-0400 (Eastern Daylight Time)

// Alternative Syntax: new Date(year, month, day, hours, min, sec, millisec)
const moonLanding = new Date(1969, 6, 21, 16, 18, 0, 0);
moonLanding; // returns Mon Jul 21, 1969 16:18:00 GMT-0400 (Eastern Daylight Time)
```

A few things to note:

1. To create a Date object containing the current date and time, the Date() constructor takes no arguments.
2. When passing the date as a string to the Date() constructor, the time portion is optional. If it is not included, it defaults to 00:00:00. Also, other date formats are acceptable (e.g., '6/21/1969' and '06-21-1969').
3. When passing date parts to the Date() constructor, dd, hh, mm, ss, and ms are all optional. The default for dd is 1; the other parameters default to 0.
4. Months are numbered from 0 (January) to 11 (December). In the example above, 6 represents July.

Some common date methods are shown below. In all the examples, the variable moonLanding contains the date Mon Jul 21, 1969 16:18:00 GMT-0400 (Eastern Daylight Time).

Common Date Methods

| Method | Description |
|-------------------|--|
| getDate() | Returns the day of the month (1-31). <pre>moonLanding.getDate(); // returns 21</pre> |
| getDay() | Returns the day of the week as a number (0-6, 0=Sunday, 6=Saturday). <pre>moonLanding.getDay(); // returns 1</pre> |
| getMonth() | Returns the month as a number (0-11, 0=January, 11=December). <pre>moonLanding.getMonth(); // returns 6</pre> |
| getFullYear() | Returns the four-digit year. <pre>moonLanding.getFullYear(); // returns 1969</pre> |
| getHours() | Returns the hour (0-23). <pre>moonLanding.getHours(); // returns 16</pre> |
| getMinutes() | Returns the minute (0-59). <pre>moonLanding.getMinutes(); // returns 18</pre> |
| getSeconds() | Returns the second (0-59). <pre>moonLanding.getSeconds(); // returns 0</pre> |
| getMilliseconds() | Returns the millisecond (0-999). <pre>moonLanding.getMilliseconds(); // returns 0</pre> |
| getTime() | Returns the number of milliseconds since midnight January 1, 1970. <pre>moonLanding.getTime(); // returns -14096520000. It's negative, because it's before the epoch.</pre> |

| Method | Description |
|----------------------|---|
| getTimezoneOffset() | Returns the time difference in minutes between the user's computer and GMT. moonLanding.getTimezoneOffset(); // returns 240 |
| toLocaleString() | Returns the Date object as a string. moonLanding.toLocaleString(); // returns '7/21/1969, 4:18:00 PM' |
| toLocaleDateString() | Returns the date portion of a Date object as a string. moonLanding.toLocaleDateString(); // returns '7/21/1969' |
| toLocaleTimeString() | Returns the Date object as a string. moonLanding.toLocaleTimeString(); // returns '4:18:00 PM' |
| toGMTString() | Returns the Date object as a string in GMT timezone. moonLanding.toGMTString(); // returns 'Mon, 21 Jul 1969 20:18:00 GMT' |

Below are the same methods from the table above shown in the Chrome DevTools Console:

```
> const moonLanding = new Date(1969, 6, 21, 16, 18, 0, 0);
<- undefined
> moonLanding;
<- Mon Jul 21 1969 16:18:00 GMT-0400 (Eastern Daylight Time)
> moonLanding.getDate();
<- 21
> moonLanding.getDay();
<- 1
> moonLanding.getMonth();
<- 6
> moonLanding.getFullYear();
<- 1969
> moonLanding.getHours();
<- 16
> moonLanding.getMinutes();
<- 18
> moonLanding.getSeconds();
<- 0
> moonLanding.getMilliseconds();
<- 0
> moonLanding.getTime();
<- -14096520000
> moonLanding.getTimezoneOffset();
<- 240
> moonLanding.toLocaleString();
<- '7/21/1969, 4:18:00 PM'
> moonLanding.toLocaleDateString();
<- '7/21/1969'
> moonLanding.toLocaleTimeString();
<- '4:18:00 PM'
> moonLanding.toGMTString();
<- 'Mon, 21 Jul 1969 20:18:00 GMT'
```

Date Documentation

See https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Date for full documentation on Date.

Let's see how we can use dates to build useful helper functions.



14.4. Helper Functions

Some languages have functions that return the month as a string. JavaScript doesn't have such a built-in function. The following sample shows a user-defined "helper" function that handles this and how the `getMonth()` method of a `Date` object can be used to get the month.

Demo 14.1: `BuiltInObjects/Demos/month-as-string.html`

```
-----Lines 1 through 7 Omitted-----
8. <script>
9.     function monthAsString(num) {
10.         const months = ["January", "February", "March", "April",
11.             "May", "June", "July", "August", "September",
12.             "October", "November", "December"];
13.         return months[num-1]; 
14.     }
15.
16.     function enterMonth() {
17.         const userMonth = prompt("What month were you born?", "");
18.         alert("You were born in " + monthAsString(userMonth) + ".");
19.     }
20.
21.     function getCurrentMonth() {
22.         const today = new Date();
23.         alert(monthAsString(today.getMonth()+1));
24.     }
25. </script>
-----Lines 26 through 34 Omitted-----
```

Run this page in your browser and then click the buttons to see how they work.

Exercise 20: Returning the Day of the Week as a String

 15 to 25 minutes

In this exercise, you will create a function that returns the day of the week as a string.

1. Open `BuiltInObjects/Exercises/date-udfs.html` for editing.
2. Write a `dayAsString()` function that returns the day of the week as a string, with "1" returning "Sunday", "2" returning "Monday", etc.
3. Write an `enterDay()` function that prompts the user for the day of the week (as a number) and then alerts the string value of that day by calling the `dayAsString()` function.
4. Write a `getCurrentDay()` function that alerts today's actual day of the week according to the user's machine.
5. Add a **CHOOSE DAY** button that calls the `enterDay()` function.
6. Add a **GET CURRENT DAY** button that calls the `getCurrentDay()` function.
7. Test your solution in a browser.

Solution: BuiltInObjects/Solutions/date-udfs.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      function monthAsString(num) {
10.          const months = [];
11.          months[0] = "January";
12.          months[1] = "February";
13.          months[2] = "March";
14.          months[3] = "April";
15.          months[4] = "May";
16.          months[5] = "June";
17.          months[6] = "July";
18.          months[7] = "August";
19.          months[8] = "September";
20.          months[9] = "October";
21.          months[10] = "November";
22.          months[11] = "December";
23.
24.          return months[num-1];
25.      }
26.
27.      function dayAsString(num) {
28.          const weekDays = [];
29.          weekDays[0] = "Sunday";
30.          weekDays[1] = "Monday";
31.          weekDays[2] = "Tuesday";
32.          weekDays[3] = "Wednesday";
33.          weekDays[4] = "Thursday";
34.          weekDays[5] = "Friday";
35.          weekDays[6] = "Saturday";
36.
37.          return weekDays[num-1];
38.      }
39.
40.      function enterMonth() {
41.          const userMonth = prompt("What month were you born?", "");
42.          alert("You were born in " + monthAsString(userMonth) + ".");
43.      }
44.
```

Evaluation
Copy

```
45.     function getCurrentMonth() {
46.         const today = new Date();
47.         alert(monthAsString(today.getMonth()+1));
48.     }
49.
50.     function enterDay() {
51.         const userDay = prompt("What day of the week is it?", "");
52.         alert("Today is " + dayAsString(userDay) + ".");
53.     }
54.
55.     function getCurrentDay() {
56.         const today = new Date();
57.         alert(dayAsString(today.getDay()+1));
58.     }
59. </script>
60. <title>Date UDFs</title>
61. </head>
62. <body>
63. <main>
64.     <button onclick="enterMonth()">CHOOSE MONTH</button>
65.     <button onclick="getCurrentMonth()">GET CURRENT MONTH</button>
66.     <hr>
67.     <button onclick="enterDay()">CHOOSE DAY</button>
68.     <button onclick="getCurrentDay()">GET CURRENT DAY</button>
69. </main>
70. </body>
71. </html>
```

Evaluation
Copy

Conclusion

In this lesson, you have learned to work with some of JavaScript's most useful built-in objects.

LESSON 15

Conditionals and Loops

Topics Covered

- if - else if - else blocks.
- switch / case blocks.
- Loops.

Introduction

In this lesson, you will learn to branch your code using `if` and `switch` conditions, and to use different types of loops.

15.1. Conditionals

There are two types of conditionals in JavaScript:

1. if - else if - else
2. switch / case

❖ 15.1.1. if - else if - else Conditions

```
if (conditions) {  
    statements;  
} else if (conditions) {  
    statements;  
} else {  
    statements;  
}
```

Like with functions, each part of the `if - else if - else` block is contained within curly brackets (`{}`). There can be zero or more `else if` blocks. The `else` block is optional.

Comparison Operators

| Operator | Description |
|--------------------|-----------------------------|
| <code>==</code> | Equals |
| <code>!=</code> | Doesn't equal |
| <code>===</code> | Strictly equals |
| <code>!==</code> | Doesn't strictly equal |
| <code>></code> | Is greater than |
| <code><</code> | Is less than |
| <code>>=</code> | Is greater than or equal to |
| <code><=</code> | Is less than or equal to |

Note the difference between `==` (equals) and `===` (strictly equals). For two objects to be **strictly equal** they must be of the same value **and** the same type, whereas to be **equal** they must only have the same value. See the code samples below:

```
▶ 0 == false;
◀ true
▶ 0 === false;
◀ false
▶ 5 == '5';
◀ true
▶ 5 === '5';
◀ false
▶ 0 == ''; // Both are falsy
◀ true
▶ 0 === '';
◀ false
```

Notice that `0` is equal to, but not *strictly equal to*, an empty string. Both these values are *falsy*, meaning that when they are treated as Booleans, they are considered to be false. More on this soon.

It is almost always better to use the strictly equals operator (`===`) and the corresponding doesn't strictly equal operator (`!==`) as these help avoid unanticipated errors.

Logical Operators

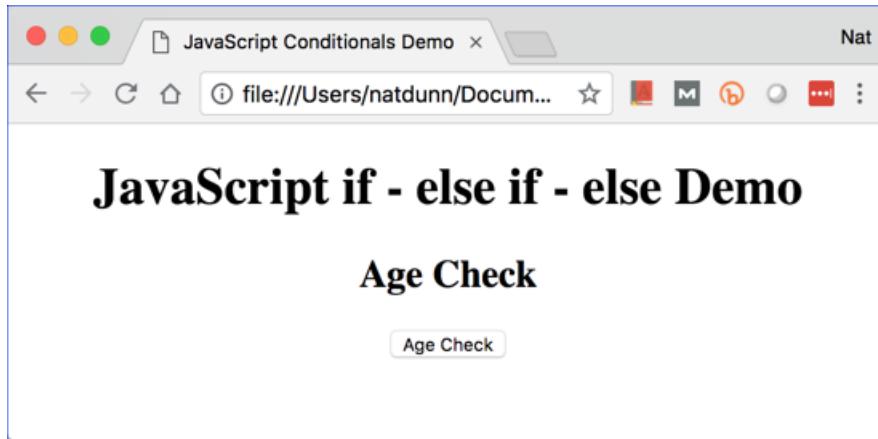
| Operator | Description | Example |
|----------|-------------|---------------------|
| && | and | (a == b && c != d) |
| | or | (a == b c != d) |
| ! | not | !(a == b c == d) |

The following example shows a function using an `if - else if - else` condition.

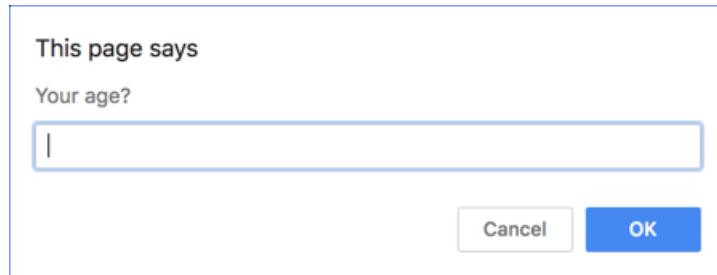
Demo 15.1: ConditionalsAndLoops/Demos/if-else-if-else.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      function checkAge() {
10.          const age = prompt("Your age?", "") || "";
11.
12.          if (age >= 21) {
13.              alert("You can vote and drink!");
14.          } else if (age >= 18) {
15.              alert("You can vote, but can't drink.");
16.          } else {
17.              alert("You cannot vote or drink.");
18.          }
19.      }
20.  </script>
21.  <title>JavaScript Conditionals Demo</title>
22.  </head>
23.  <body>
24.  <main>
25.      <h1>JavaScript if - else if - else Demo</h1>
26.      <h2>Age Check</h2>
27.      <button onclick="checkAge()">Age Check</button>
28.  </main>
29.  </body>
30. </html>
```

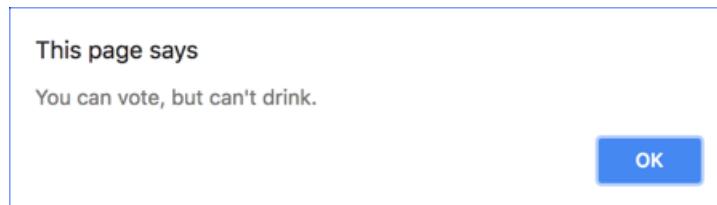
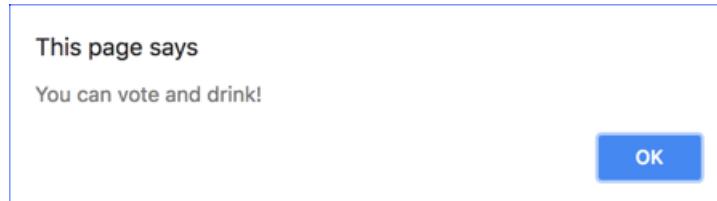
The display of the page is shown below:



When the user clicks the **Age Check** button, the following prompt pops up:



After the user enters their age, an alert pops up. The text of the alert depends on the user's age. The three possibilities are shown below:



This page says

You cannot vote or drink.

OK

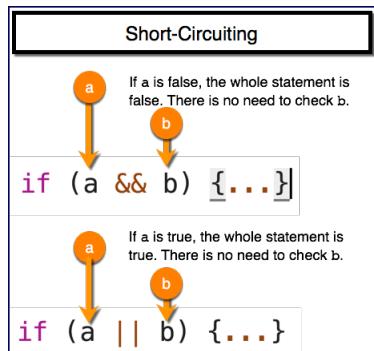
Compound Conditions

Compound conditions are conditions that check for multiple things. See the following sample:

```
if (age > 18 && isCitizen) {  
    alert("You can vote!");  
}  
  
if (age >= 16 && (isCitizen || hasGreenCard)) {  
    alert("You can work in the United States");  
}
```

15.2. Short-circuiting

JavaScript is lazy (or efficient) about processing compound conditions. As soon as it can determine the overall result of the compound condition, it stops looking at the remaining parts of the condition:



Short-circuiting is useful for checking that a variable is of the right data type before you try to manipulate it.

To illustrate, take a look at the following sample:

Demo 15.2: ConditionalsAndLoops/Demos/password-check-broken.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const userPass = prompt("Password:", ""); //ESC here causes problems
10.   const pw = "xyz";
11.  </script>
12.  <title>Password Check</title>
13.  </head>
14.  <body>
15.  <main>
16.    <script>
17.      if (userPass.toLowerCase() === pw) {
18.        document.write("<h1>Welcome!</h1>");
19.      } else {
20.        document.write("<h1>Bad Password!</h1>");
21.      }
22.    </script>
23.  </main>
24.  </body>
25. </html>
```

Evaluation
Copy

Everything works fine as long as the user does what you expect. However, if the user clicks the **Cancel** button when prompted for a password, the value `null` will be assigned to `userPass`. Because `null` is not a string, it does not have the `toLowerCase()` method. So the following line will result in a JavaScript error:

```
if (userPass.toLowerCase() === pw)
```

You can see the error in Chrome DevTools Console:

```
✖ ▶ Uncaught TypeError: password-check-broken.html:16
  Cannot read property 'toLowerCase' of null
  at password-check-broken.html:16
```

This can be fixed by using `typeof` (described below) to first check if `userPass` is a string as shown in the following sample:

The typeof Operator

The `typeof` operator is used to find out the type of a piece of data. The following screenshot shows what the `typeof` operator returns for different data types:

```
> typeof false;
< "boolean"
> typeof 5;
< "number"
> typeof 'hello';
< "string"
> typeof [];
< "object"
> typeof function() {};
< "function"
> typeof alert;
< "function"
> typeof window.document;
< "object"
> typeof null;
< "object"
> typeof undefined;
< "undefined"
> typeof foo; // We haven't defined this variable
< "undefined"
```

Demo 15.3: ConditionalsAndLoops/Demos/password-check.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const userPass = prompt("Password:", "");
10.   const pw = "xyz";
11.  </script>
12.  <title>Password Check</title>
13.  </head>
14.  <body>
15.  <main>
16.    <script>
17.      if (typeof userPass === "string" && userPass.toLowerCase() === pw) {
18.        document.write("<h1>Welcome!</h1>");
19.      } else {
20.        document.write("<h1>Bad Password!</h1>");
21.      }
22.    </script>
23.  </main>
24.  </body>
25. </html>
```



Now, if the user presses **Cancel** and `userPass` gets `null`, this check will fail: `typeof userPass === "string"`. Because the `if` condition uses `&&` requiring that both conditions are true for the whole statement to be true, there is no reason to check the second condition if the first condition is false. So, JavaScript short circuits, meaning it immediately returns `false` without wasting time checking the second condition.

Short circuiting also works with **or** conditions (e.g., `if (a or b)`). In this case, the whole statement is true if either side of the `or` condition is true. So, if `a` is true, there is no reason to check `b`. JavaScript will short circuit and return `true`.



15.3. Switch / Case

```
switch (expression) {  
    case value :  
        statements;  
    case value :  
        statements;  
    default :  
        statements;  
}
```

Evaluation
Copy

Like `if - else if - else` statements, `switch / case` statements are used to run different code at different times. Unlike `if` statements, `switch / case` statements are limited to checking for equality. Each case is checked to see if the *expression* matches the *value*.

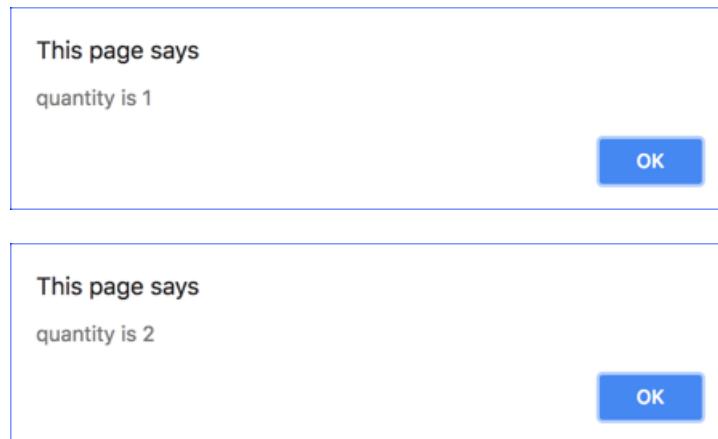
Take a look at the following example:

Demo 15.4: ConditionalsAndLoops/Demos/switch-without-break.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    const quantity = 1;
10.   switch (quantity) {
11.     case 1 :
12.       alert("quantity is 1");
13.     case 2 :
14.       alert("quantity is 2");
15.     default :
16.       alert("quantity is not 1 or 2");
17.   }
18. </script>
19. <title>Switch</title>
20. </head>
21. <body>
22. <main>
23.   <p>Nothing to show here.</p>
24. </main>
25. </body>
26. </html>
```

Evaluation
Copy

When you run this page in a browser, you'll see that all three alerts pop up, even though only the first case is a match:



This page says
quantity is not 1 or 2

OK

That's because if a match is found, none of the remaining cases are checked and all the remaining statements in the `switch` block are executed. To stop this process, you can insert a `break` statement, which will end the processing of the `switch` statement.

The corrected code is shown in the following example:

Demo 15.5: ConditionalsAndLoops/Demos/switch-with-break.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  const quantity = 1;
10. switch (quantity) {
11.   case 1 :
12.     alert("quantity is 1");
13.     break;
14.   case 2 :
15.     alert("quantity is 2");
16.     break;
17.   default :
18.     alert("quantity is not 1 or 2");
19. }
20. </script>
21. <title>Switch</title>
22. </head>
23. <body>
24. <main>
25.   <p>Nothing to show here.</p>
26. </main>
27. </body>
28. </html>
```

The following example shows how a `switch` / `case` statement can be used to decide what math operation to perform:

Evaluation
Copy

Demo 15.6: ConditionalsAndLoops/Demos/do-math.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      function doMath(operator) {
10.          const n1 = parseFloat(document.getElementById('n1').value);
11.          const n2 = parseFloat(document.getElementById('n2').value);
12.          let result;
13.          switch (operator) {
14.              case "+":
15.                  result = n1 + n2;
16.                  break;
17.              case "-":
18.                  result = n1 - n2;
19.                  break;
20.              case "*":
21.                  result = n1 * n2;
22.                  break;
23.              case "/":
24.                  result = n1 / n2;
25.                  break;
26.              default:
27.                  alert("Bad operator");
28.          }
29.          alert(n1 + operator + n2 + '=' + result);
30.      }
31.  </script>
32.  <title>doMath</title>
33.  </head>
34.  <body>
35.  <main>
36.      <label for="n1">First Number:</label> <input id="n1">
37.      <label for="n2">Second Number:</label> <input id="n2">
38.      <button onclick="doMath('+')">Add</button>
39.      <button onclick="doMath('-')">Subtract</button>
40.      <button onclick="doMath('*')">Multiply</button>
41.      <button onclick="doMath('/')">Divide</button>
42.  </main>
43.  </body>
44. </html>
```

Evaluation
Copy

Use Case for switch Without break

In most cases, you will include `break` statements in your `switch` conditions; however, there are cases when it makes sense to continue to execute all the subsequent statements in a `switch` condition after a match has been found. Consider the following, in which permissions are being added to an array based on a user's role:

```
const role = 'Admin';
const permissions = [];
switch (role) {
  case 'SuperAdmin':
    permissions.push('delete');
  case 'Admin':
    permissions.push('update');
  case 'Contributor':
    permissions.push('create');
  default:
    permissions.push('read');
}
console.log(permissions);
```

Evaluation
Copy

The code above will log (3) `['update', 'create', 'read']` to the console. That's because `role` is set to `'Admin'`. The logic works as follows:

1. Does `role` contain `'SuperAdmin'`? No, it does not. So, it doesn't push `'delete'` onto the `permissions` array.
2. Does `role` contain `'Admin'`? Yes, it does. So, it pushes `'update'` onto the `permissions` array.
3. Then, it stops checking the cases, because it already found the match. And it continues executing all the statements until it finds a `break` or it reaches the end of the `switch` statement. In this case, there are no `break` statements, so it pushes `'create'` and `'update'` onto the `permissions` array.

The result is that SuperAdmin will get all permissions. Admin will get `update`, `create`, and `read` permissions. Contributor will get `create` and `read` permissions. All others will only get `read` permissions.

Order of Conditions

In conditional statements it's generally a good practice to test for the most likely cases/matches first so the browser can find the correct code to execute more quickly.



15.4. Ternary Operator

The ternary operator provides a shortcut for if conditions. The syntax is as follows:

```
const constName = (condition) ? valueIfTrue : valueIfFalse;
```

For example:

```
const evenOrOdd = (number % 2 === 0) ? "even" : "odd";
```

The following code sample shows how the ternary operator works:

Demo 15.7: ConditionalsAndLoops/Demos/ternary.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9.   const num = parseInt(prompt("Enter a number.", ""));
10.
11.  //without ternary
12.  if (num % 2 === 0) {
13.    alert(num + " is even.");
14.  } else {
15.    alert(num + " is odd.");
16.  }
17.
18.  //with ternary
19.  const term = num % 2 === 0 ? "even" : "odd";
20.  alert(num + " is " + term);
21. </script>
-----Lines 22 through 29 Omitted-----
```

The first block shows a regular if-else statement.

The second block shows how to accomplish the same thing in a couple of lines of code with the ternary operator.



15.5. Truthy and Falsy

JavaScript has a boolean data type, which has only two possible values: `true` or `false`. In addition, every value and expression in JavaScript can be converted to `true` or `false`.

When a non-boolean literal value, variable, or expression is used in a boolean context (e.g., an if condition or with the `default` operator), it is implicitly converted to a boolean. This process is called *Type Coercion*. For example, look at the following code, which uses the default operator:

```
const a = 1 || 2;
```

The value `1` is interpreted as `true`, so `a` will get `1`. Non-boolean values that are treated as `true` when used in a boolean context are said to be *truthy*.

Now examine the following code:

```
const a = 0 || 2;
```

The value `0` is interpreted as `false`, so `a` will get `2`. Non-boolean values that are treated as `false` when used in a boolean context are said to be *falsy*.

The only *falsy* values are:

1. `0`, but not `"0"`, which is a string.
2. `""` – a zero-length string.
3. `null`
4. `undefined`
5. `NaN` – a special `number` value that means “Not a Number”. For example, `NaN` is the result of dividing `0` by `0` or finding the square root of a negative number (e.g. `Math.sqrt(-1)`).

All other values are *truthy*.

Evaluation
Copy



Exercise 21: Conditional Processing



20 to 30 minutes

In this exercise, you will practice using conditional processing.

1. Open `ConditionalsAndLoops/Exercises/conditionals.html` for editing.
2. Notice that there is an `onclick` event handler on the button that calls the `greetUser()` function. Create this function in the `script` block.
3. The function should do the following:
 - A. Ask (via a prompt) if the user is right- or left-handed.
 - B. If the user enters a value other than “right” or “left”, prompt again.
 - C. Ask (via a prompt) for the user’s last name.
 - D. If the user leaves the last name blank, prompt again.
 - E. If the user enters a number for the last name, alert that a last name can’t be a number and prompt again.
 - F. After collecting the user’s dominant hand and last name:
 - If the dominant hand is valid, pop up an alert that greets the user appropriately (e.g., “Hello Lefty Smith!”)
 - If the dominant hand is not valid, pop up an alert that reads something like “XYZ is not a valid value for dominant hand!”
4. Test your solution in a browser.

Challenge

1. Allow the user to enter the dominant hand in any case (e.g., left, Left, LEFT, right, Right, RIGHT).
2. If the user enters a last name that does not start with a capital letter, prompt to try again.

Solution: ConditionalsAndLoops/Solutions/conditionals.html

```
-----Lines 1 through 7 Omitted-----  
8. <script>  
9. function greetUser() {  
10.   let dominantHand;  
11.   let lastName;  
12.  
13.   dominantHand = prompt("Are you left- or right-handed?", "") || "";  
14.   if (dominantHand !== "right" && dominantHand !== "left") {  
15.     dominantHand = prompt("Try again: right or left?", "") || "";  
16.   }  
17.  
18.   lastName = prompt("What's your last name?", "") || "";  
19.   if (lastName.length === 0) {  
20.     lastName = prompt("No last name? Please re-enter:", "") || "";  
21.   } else if (!isNaN(lastName)) {  
22.     lastName = prompt("Names aren't numbers. Re-enter:", "") || "";  
23.   }  
24.  
25.   switch (dominantHand) {  
26.     case "right" :  
27.       alert("Hello Righty " + lastName + "!");  
28.       break;  
29.     case "left" :  
30.       alert("Hello Lefty " + lastName + "!");  
31.       break;  
32.     default :  
33.       alert(dominantHand + " is not a valid value for dominant hand!");  
34.   }  
35. }  
36. </script>
```

-----Lines 37 through 44 Omitted-----

Challenge Solution: ConditionalsAndLoops/Solutions/conditionals-challenge.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9. function greetUser() {
10.   let dominantHand;
11.   let lastName;
12.
13.   dominantHand = prompt("Are you left- or right-handed?", "") || "";
14.   dominantHand = dominantHand.toLowerCase();
15.   if (dominantHand !== "right" && dominantHand !== "left") {
16.     dominantHand = prompt("Try again: right or left?", "") || "";
17.   }
18.
19.   lastName = prompt("What's your last name?", "") || "";
20.   const firstLetter = lastName.substring(0, 1);
21.   if (lastName.length === 0) {
22.     lastName = prompt("No last name? Please re-enter:", "") || "";
23.   } else if (!isNaN(lastName)) {
24.     lastName = prompt("Names aren't numbers. Re-enter:", "") || "";
25.   } else if (firstLetter === firstLetter.toLowerCase()) {
26.     lastName = prompt("Names begin with capital letters. Re-enter:", "") || "";
27.   }
28.
29.   switch (dominantHand) {
30.     case "right" :
31.       alert("Hello Righty " + lastName + "!");
32.       break;
33.     case "left" :
34.       alert("Hello Lefty " + lastName + "!");
35.       break;
36.     default :
37.       alert(dominantHand + " is not a valid value for dominant hand!");
38.   }
39. }
40. </script>
-----Lines 41 through 48 Omitted-----
```



15.6. Loops

There are several types of loops in JavaScript:

- while
 - do...while
 - for
 - for...in
 - for...of
-

*

15.7. while and do...while Loops

❖ 15.7.1. while Loop Syntax

```
while (conditions) {  
    statements;  
}
```

Evaluation
Copy

The `while` loop first checks one or more conditions and then executes the statements in its body as long as those conditions are true. Something, usually a statement within the `while` block, must cause the condition to change so that it eventually becomes false and causes the loop to end. Otherwise, you get stuck in an infinite loop, which can bring down the browser.

Here is an example of a `while` loop:

```
let i=0;  
while (i < 5) {  
    console.log(i);  
    i++; // changing value of i  
}
```

And here's the above code executed at Chrome DevTools Console:

```
> let i = 0;
  while (i < 5) {
    console.log(i);
    i++;
}
0
1
2
3
4
```

❖ 15.7.2. do...while Loop Syntax

```
do {
  statements;
} while (conditions);
```

The `do...while` loop checks the conditions *after* each execution of the statements in the body. Again, something, usually a statement within the `do` block, must cause the condition to change so that it eventually becomes false and causes the loop to end.

Here is an example of a `do...while` loop:

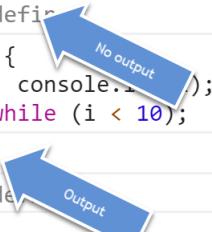
```
let i=0;
do {
  console.log(i);
  i++; // changing value of i
} while (i < 5);
```

And here's the above code executed at Chrome DevTools Console:

```
> let i = 0;
  do {
    console.log(i);
    i++;
  } while (i < 5);
0
1
2
3
4
```

Unlike with `while` loops, the statements in `do...while` loops will always execute at least one time because the conditions are not checked until the end of each iteration. The following code illustrates this:

```
let i = 10;
while (i < 10) {
    console.log(i);
}
undefined
do {
    console.log(i);
} while (i < 10);
10
undefined
|
```



*

15.8. for Loops

❖ 15.8.1. for Loop Syntax

Evaluation
Copy

```
for (initialization; conditions; change) {
    statements;
}
```

In `for` loops, the initialization, conditions, and change are all placed up front and separated by semi-colons. This makes it easy to remember to include a change statement that will eventually cause the loop to end.

`for` loops are often used to iterate through arrays. The `length` property of an array can be used to check how many elements the array contains. For example:

```
const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];
for (let i=0; i<fruit.length; i++) {
    console.log(fruit[i]);
}
```

And here's the above code executed at Chrome DevTools Console:

```
> const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];
  for (let i=0; i < fruit.length; i++) {
    console.log(fruit[i]);
  }
Apples
Oranges
Bananas
Pears
```

❖ 15.8.2. for...of Loop Syntax

```
for (let item of iterable) {
  statement;
}
```

for...of loops are used to loop through any *iterable object* – usually arrays, but there are other types of iterable objects as well. For example:

```
const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];
for (let i of fruit) {
  console.log(i);
}
```

Evaluation
Copy

And here's the above code executed at Chrome DevTools Console:

```
> const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];
  for (let i of fruit) {
    console.log(i);
  }
Apples
Oranges
Bananas
Pears
```

❖ 15.8.3. for...in Loop Syntax

```
for (let item in object) {
  statements;
}
```

`for ...in` loops are used to loop through object properties. A common mistake is to use this type of loop to iterate through arrays. Most of the time, this will work fine, but for reasons that are beyond the scope of this course, you should avoid using `for ...in` loops to iterate through arrays. We cover the syntax here only because you are likely to see this type of loop used incorrectly and we want you to be able to recognize it. If you would like to learn more why it should be avoided, see https://developer.mozilla.org/en-US/docs/Web/JavaScript/Guide/Loops_and_iteration#Arrays.



15.9. break and continue

The `break` statement is used to break out of a loop, usually when some condition is met.

```
for (let item of object) {  
    doSomething(item);  
    if (conditions) {  
        break;  
        // loop will stop executing  
        // and afterLoop() will run  
    }  
}  
afterLoop();
```

Evaluation
Copy

The following code illustrates how `break` works:

```
> const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];  
for (let i of fruit) {  
    console.log(i);  
    if (i.indexOf('an') >= 0) {  
        break;  
    }  
}  
Apples  
Oranges
```

Notice that the Bananas and Pears do not get logged, because the loop is broken as soon as Oranges, which contains “an” is found.

The `continue` statement is used to move on to the next iteration of the loop. It is used when a condition is met that makes it unnecessary to run the rest of the code in the loop body for that iteration.

```
for (let item of object) {  
    doSomething(item);  
    if (conditions) {  
        continue;  
        // loop will move on to next item  
        // doSomethingElse() won't be executed for this item  
    }  
    doSomethingElse(item);  
}
```

The following code illustrates how `continue` works:

```
> const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];  
> for (let i of fruit) {  
    >     if (i.indexOf('an') >= 0) {  
    >         continue;  
    >     }  
    >     console.log(i);  
    > }  
> Apples  
> Pears
```

Notice that the Oranges and Bananas do not get logged, because both contain “an”, and when that condition is met, the loop moves on to the next iteration.

Exercise 22: Working with Loops

 20 to 30 minutes

In this exercise, you will practice working with loops.

1. Open `ConditionalsAndLoops/Exercises/loops.html` for editing. You will see that this file is similar to the solution to the challenge from the last exercise.
2. Declare an additional variable called `greeting`.
3. Create an array called `presidents` that contains the last names of four or more past presidents.
4. Currently, the user only gets two tries to enter a valid `dominantHand` and `lastName`. Modify the code so that, in both cases, the user continues to get prompted until the data is valid.
 - A. For `dominantHand`, the first prompt should be “Are you left- or right-handed?” Each subsequent prompt should be “Try again: right or left?”
 - B. For `lastName`, it should just continue prompting “What’s your last name?” until the user enters a valid last name.
5. Change the `switch` block so that it assigns an appropriate value (e.g., “Hello Lefty Smith”) to the `greeting` variable rather than popping up an alert.
6. After the `switch` block, write code that alerts the user by name if they have the same last name as a president. There is no need to alert those people who have non-presidential names.

Challenge

1. For those people who do not have presidential names, pop up an alert that tells them their names are not presidential.

Solution: ConditionalsAndLoops/Solutions/loops.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9. function greetUser() {
10.   let dominantHand;
11.   let lastName;
12.   let greeting;
13.   const presidents = ["Washington", "Jefferson", "Lincoln", "Kennedy"];
14.
15.   dominantHand = prompt("Are you left- or right-handed?", "") || "";
16.   dominantHand = dominantHand.toLowerCase();
17.   while (dominantHand !== "right" && dominantHand !== "left") {
18.     dominantHand = prompt("Try again: right or left?", "") || "";
19.   }
20.
21.   do {
22.     lastName = prompt("What's your last name?", "") || "";
23.   } while (lastName.length === 0
24.           || isNaN(lastName)
25.           || lastName.substring(0, 1) === lastName.substring(0, 1).toLowerCase())
26.
27.   switch (dominantHand) {
28.     case "right" :
29.       greeting = "Hello Righty " + lastName + "!";
30.       break;
31.     default : // If not right, must be left
32.       greeting = "Hello Lefty " + lastName + "!";
33.   }
34.
35.   for (let lName of presidents) {
36.     if (lName === lastName) {
37.       alert(greeting + ' Your name is presidential!');
38.       break; // No need to keep looking after we've found a match
39.     }
40.   }
41. }
42. </script>
-----Lines 43 through 50 Omitted-----
```

Challenge Solution: ConditionalsAndLoops/Solutions/loops-challenge.html

```
-----Lines 1 through 34 Omitted-----  
35. let match = false;  
36. for (let lName of presidents) {  
37.   if (lName === lastName) {  
38.     alert(greeting + ' Your name is presidential!');  
39.     match = true;  
40.   break; // No need to keep looking after we've found a match  
41.   }  
42. }  
43. if (!match) {  
44.   alert(greeting + ' Your name is not presidential!');  
45. }  
-----Lines 46 through 55 Omitted-----
```

15.10. Array: forEach() *Evaluation Copy*

Another way to loop through arrays is to use the array's built-in `forEach()` method.

```
myArray.forEach( function(item) {  
  doSomething(item);  
});
```

Each item of the array is passed to the function one by one. For example:

```
const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];  
fruit.forEach(function(item) {  
  console.log(item);  
});
```

And here's the above code executed at Chrome DevTools Console:

```
> const fruit = ['Apples', 'Oranges', 'Bananas', 'Pears'];
  fruit.forEach( function(item) {
    console.log(item);
  });
  Apples
  Oranges
  Bananas
  Pears
```

Conclusion

Evaluation
Copy

In this lesson, you learned:

- To work with `if-else if-else` conditions.
- To work with `switch / case` conditionals.
- To work with several types of loops.

LESSON 16

Event Handlers and Listeners

Topics Covered

- Understanding on-event handlers.
- Commonly-used on-event handlers.
- `addEventListener()`.
- Benefits of event listeners.

Introduction

Evaluation
Copy

On-event handlers allow us to listen for user actions and to respond to those events with custom code.



16.1. On-event Handlers

On-event handlers are attributes that force an element to “listen” for a specific event to occur.

We might, for instance, listen for a user to click a specific `div` element, listen for a form submission, or listen for the user to pass their mouse over any `input` element of a given class.

The table below lists commonly-used HTML on-event handlers with descriptions:

HTML On-event Handlers

| On-event Handler | Description |
|------------------|---|
| onblur | The element lost the focus. |
| onchange | The element value was changed. |
| onclick | A pointer button was clicked. |
| ondblclick | A pointer button was double-clicked. |
| onfocus | The element received the focus. |
| onkeydown | A key was pressed down. |
| onkeypress | A key was pressed and released. |
| onkeyup | A key was released. |
| onload | The document has been loaded. |
| onmousedown | A pointer button was pressed down. |
| onmousemove | A pointer was moved within the element. |
| onmouseout | A pointer was moved off of the element. |
| onmouseover | A pointer was moved onto the element. |
| onmouseup | A pointer button was released over the element. |
| onreset | The form was reset. |
| onselect | Some text was selected. |
| onsubmit | The form was submitted. |

❖ 16.1.1. The getElementById() Method

A very common way to reference HTML elements is by their `id` using the `getElementById()` method of the `document` object as shown in the following example. Once we have the element – that is, once we get a given `div`, `p`, `input` or other DOM element via the `getElementById()` method – we can then listen for events on that element. Let's look at an example:

Demo 16.1: EventHandlers/Demos/get-element-by-id.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  function changeBg(id, color) {
10.    document.getElementById(id).style.backgroundColor = color;
11.  }
12. </script>
13. <title>getElementById()</title>
14. </head>
15. <body>
16. <main>
17.   <button onclick="changeBg('divRed', 'red')">Red</button>
18.   <button onclick="changeBg('divOrange', 'orange')">Orange</button>
19.   <button onclick="changeBg('divGreen', 'green')">Green</button>
20.   <button onclick="changeBg('divBlue', 'blue')">Blue</button>
21.   <div id="divRed">Red</div>
22.   <div id="divOrange">Orange</div>
23.   <div id="divGreen">Green</div>
24.   <div id="divBlue">Blue</div>
25. </main>
26. </body>
27. </html>
```

Clicking the buttons sets the style of the corresponding div element, whose id is gotten via a call to `getElementById()` in the `changeBg()` function.

Exercise 23: Using On-event Handlers

 15 to 25 minutes

In this exercise, you will use on-event handlers to allow the user to change the background color of the page.

1. Open EventHandlers/Exercises/color-changer.html for editing.
2. Modify the page so that...
 - When the “Red” button is *clicked*, the background color turns red.
 - When the “Green” button is *double-clicked*, the background color turns green.
 - When the “Orange” button is *clicked down*, the background color turns orange and when the button is released (*onmouseup*), the background color turns white.
 - When the mouse hovers over the “pink” link, the background color turns pink. When it hovers off, the background color turns white.

Exercise Code 23.1: EventHandlers/Exercises/color-changer.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <title>Color Changer</title>
9.  </head>
10. <body>
11. <main>
12.   <button>
13.     Click to turn the page red.
14.   </button>
15.   <button>
16.     Double-click to turn the page green.
17.   </button>
18.   <button>
19.     Click and hold to turn the page orange.
20.   </button>
21.   <a href="#">Hover over to turn page pink.</a>
22. </main>
23. </body>
24. </html>
```

Evaluation
Copy

Challenge

1. Add functionality so that when the user presses any key, the background color turns white.

Solution: EventHandlers/Solutions/color-changer.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  function changeBg(color) {
10.    document.body.style.backgroundColor = color;
11.  }
12. </script>
13. <title>Color Changer</title>
14. </head>
15. <body>
16. <main>
17.   <button onclick="changeBg('red')">
18.     Click to turn the page red.
19.   </button>
20.   <button ondblclick="changeBg('green')">
21.     Double-click to turn the page green.
22.   </button>
23.   <button onmousedown="changeBg('orange')"
24.         onmouseup="changeBg('white')">
25.     Click and hold to turn the page orange.
26.   </button>
27.   <a href="#">
28.     onmouseover="changeBg('pink')"
29.     onmouseout="changeBg('white')">Hover over to turn page pink.</a>
30. </main>
31. </body>
32. </html>
```



Challenge Solution: EventHandlers/Solutions/color-changer-challenge.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.  function changeBg(color) {
10.    document.body.style.backgroundColor = color;
11. }
12. </script>
13. <title>Color Changer</title>
14. </head>
15. <body onkeypress="changeBg('white')">
16. <main>
17.   <button onclick="changeBg('red')">
18.     Click to turn the page red.
19.   </button>
20.   <button ondblclick="changeBg('green')">
21.     Double-click to turn the page green.
22.   </button>
23.   <button onmousedown="changeBg('orange')"
24.         onmouseup="changeBg('white')">
25.     Click and hold to turn the page orange.
26.   </button>
27.   <a href="#" onmouseover="changeBg('pink')"
28.       onmouseout="changeBg('white')">Hover over to turn page pink.</a>
29. </main>
30. </body>
31. </html>
```

Evaluation
Copy

*

16.2. The addEventListener() Method

You have learned how to add *event handlers* using the on-event HTML attributes (e.g., `onload`, `onclick`, etc). Now, you will learn how to add *event listeners* using an `EventTarget`'s `addEventListener()` method.

An `EventListener` represents an object that does something when an event occurs. Think of a swimmer on a block, waiting for the starting gun to go off. When the gun goes off, the swimmer dives. Here is some pseudo-code to set that up in JavaScript:

```
diver.addEventListener('shotFire', dive);
```

In the pseudo-code above, `diver` is the `EventTarget`, `shotFire` is the event type, and `dive` is the function that will be called when the event occurs. Functions that are called in response to an event are known as *callback functions*.

An `EventTarget` is any object on which an event can occur, including `window`, `document`, and any HTML element. The basic syntax is as follows:

```
object.addEventListener(eventType, callbackFunction);
```

We have already seen the different types of events: `click`, `dblclick`, `load`, `mouseover`, `mouseout`, etc. HTML attributes used to call these events all begin with “on”, but when referencing the event type directly, you do not include the “on” prefix. For example, the following code shows how to call the `init()` function when the `load` event of the `window` object occurs:

Demo 16.2: EventHandlers/Demos/window-load.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    function init(e) {
10.      alert('Hello, world!');
11.    }
12.    window.addEventListener('load', init);
13.  </script>
14.  <title>window load</title>
15. </head>
16. <body>
17. <main>
18.   <p>Nothing to show here.</p>
19. </main>
20. </body>
21. </html>
```

Evaluation
Copy

Run this in the browser and you will see the “Hello, world!” alert as soon as the page is finished loading.

Notice in the code above that `init` is passed to `addEventListener()` without the usual trailing parentheses associated with functions. It is `window.addEventListener('load', init);` and not `window.addEventListener('load', init());`. The reason is that we are not *calling* the function at this point in the code. Rather, we are indicating that we want the function to be called when the relevant event occurs. If you make the mistake of including the parentheses, the function will be called immediately and the value returned from the function will be used as the callback function, probably resulting in an error.

The table below lists common event types with descriptions. These correspond to the on-event handlers we saw earlier.

Event Types

| Event Type | Description |
|------------|---|
| blur | The element lost the focus. |
| change | The element value was changed. |
| click | A pointer button was clicked. |
| dblclick | A pointer button was double-clicked. |
| focus | The element received the focus. |
| keydown | A key was pressed down. |
| keyup | A key was released. |
| load | The document has been loaded. |
| mousedown | A pointer button was pressed down. |
| mousemove | A pointer was moved within the element. |
| mouseout | A pointer was moved off of the element. |
| mouseover | A pointer was moved onto the element. |
| mouseup | A pointer button was released over the element. |
| reset | The form was reset. |
| select | Some text was selected. |
| submit | The form was submitted. |

The Callback Function

In the example above, the callback function is `init(e)`. You may have noticed that it takes a single parameter, which we have called `e`, but the variable name is arbitrary. Common names are `e` and `evt`. This parameter will hold the *event* that caused the callback function to be called. Examine the following:

Demo 16.3: EventHandlers/Demos/window-load-e.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    function init(e) {
10.      alert(e);
11.      alert(e.currentTarget);
12.      alert(e.type);
13.    }
14.    window.addEventListener('load', init);
15.  </script>
16.  <title>window load</title>
17.  </head>
18.  <body>
19.  <main>
20.    <p>Nothing to show here.</p>
21.  </main>
22.  </body>
23. </html>
```

Evaluation
Copy

This time, instead of alerting “Hello, world!”, the code alerts [object Event]:



and then alerts the `currentTarget` property of the event, which is the object that caused the event to occur: [object Window]:

This page says
[object Window]

OK

Finally, it alerts the type of event: load:

This page says
load

OK

Now let's take a look at how we use this passing of the event to make a function's response dependent on the event that spawned it:

Demo 16.4: EventHandlers/Demos/current-target.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      function changeBg(e) {
10.          const color = e.currentTarget.id;
11.          document.body.style.backgroundColor = color;
12.      }
13.
14.      function init(e) {
15.          const aqua = document.getElementById('aqua');
16.          const lime = document.getElementById('lime');
17.          const pink = document.getElementById('pink');
18.          aqua.addEventListener('click', changeBg);
19.          lime.addEventListener('click', changeBg);
20.          pink.addEventListener('click', changeBg);
21.      }
22.      window.addEventListener('load', init);
23.  </script>
24.  <title>window load</title>
25.  </head>
26.  <body>
27.  <main>
28.      <button id="aqua">Aqua</button>
29.      <button id="lime">Lime</button>
30.      <button id="pink">Pink</button>
31.  </main>
32.  </body>
33.  </html>
```

Run this page in your browser to see how it works.

1. When the page is loaded the `init()` function is called. It adds event listeners to each of the buttons, all with the same callback function: `changeBg`. Note that we have to add these event listeners **after** the document loads to be sure that the buttons exist. That is why we do it in the callback function of `window's load` event.

2. The callback function, `changeBg()`, sets the `color` variable to the value of the `id` of the event's `currentTarget` – the button that was clicked. It then changes the background color to `color`.

*

16.3. Anonymous Functions

The `init()` function in the previous example is meant to be called once and only once – when the page finishes loading. As such, there is no reason for it to remain available after it is run. Such functions are often created as *anonymous functions* at the point in the code that they are needed. The syntax is as follows:

```
object.addEventListener(eventType, function(e) {  
  // function code here  
});
```

Notice the function has no name: `function init(e)` is replaced with `function(e)`. It doesn't need a name, because it will only be referenced this one time in the code.

Here is the last page rewritten to use an anonymous function:

Demo 16.5: EventHandlers/Demos/anonymous-function.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width, initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      function changeBg(e) {
10.          const color = e.currentTarget.id;
11.          document.body.style.backgroundColor = color;
12.      }
13.
14.      window.addEventListener('load', function(e) {
15.          const aqua = document.getElementById('aqua');
16.          const lime = document.getElementById('lime');
17.          const pink = document.getElementById('pink');
18.          aqua.addEventListener('click', changeBg);
19.          lime.addEventListener('click', changeBg);
20.          pink.addEventListener('click', changeBg);
21.      });
22.  </script>
23.  <title>Anonymous Function</title>
24.  </head>
25.  <body>
26.  <main>
27.      <button id="aqua">Aqua</button>
28.      <button id="lime">Lime</button>
29.      <button id="pink">Pink</button>
30.  </main>
31.  </body>
32.  </html>
```

Run this page in your browser and you'll see that it works the same as it did with a named function.

Note that we could make `changeBg()` an anonymous function as well, but because it is called three times, we would have to change it each place it is called. If we ever wanted to make modifications in the future, we would have to make those modifications in all three places. So, as it is reused, it makes more sense to give that one a name.



16.4. Capturing Key Events

The three types of keyboard events are:

1. keydown – fires when a key is pressed down.
2. keyup – fires when a key is released.

The target of keyboard events can be the document or any element on the page.

When capturing a keyboard event, it is common to want to know what key is pressed. This is available via the event's key property.

Demo 16.6: EventHandlers/Demos/keys.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.    document.addEventListener('keyup', function(e) {
10.      document.getElementById('keyholder').innerHTML = e.key;
11.    });
12.  </script>
13.  <title>Key Press</title>
14.  </head>
15.  <body>
16.  <main id="keyholder"></main>
17.  </body>
18.  </html>
```

Run this page in your browser and press any key to see how it works. Notice that when you press the **Enter** key, the word “Enter” is output. You could use the following code to capture this on an input field:

```
const myInput = document.getElementById('myInput');
myInput.addEventListener('keyup', function(e) {
  if (e.key === 'Enter') {
    doSomething();
  }
});
```

innerHTML

This demo uses the `innerHTML` property, which you can use to read and modify the HTML content of an element.



Exercise 24: Adding Event Listeners



15 to 25 minutes

You will start with the following code:

Exercise Code 24.1: EventHandlers/Exercises/add-event-listener.html

```
1.  <!DOCTYPE html>
2.  <html lang="en">
3.  <head>
4.  <meta charset="UTF-8">
5.  <meta name="viewport" content="width=device-width,initial-scale=1">
6.  <link rel="stylesheet" href="../normalize.css">
7.  <link rel="stylesheet" href="../styles.css">
8.  <script>
9.      // write changeBg function here
10.
11.     function changeBgWhite(e) {
12.         document.body.style.backgroundColor = 'white';
13.     }
14.
15.     // add your event listener here
16. </script>
17. <title>Color Changer</title>
18. </head>
19. <body>
20. <main>
21.     <button id="red">
22.         Click to turn the page red.
23.     </button>
24.     <button id="green">
25.         Double-click to turn the page green.
26.     </button>
27.     <button id="orange">
28.         Click and hold to turn the page orange.
29.     </button>
30.     <a href="#" id="pink">Hover over to turn page pink.</a>
31. </main>
32. </body>
33. </html>
```



1. Open EventHandlers/Exercises/add-event-listener.html in your editor.

2. Add an event listener to capture the `load` event of the `window` object. The callback function should be anonymous and should do the following:
 - A. Create variables holding the buttons and link.
 - B. Add a `click` event to the red button that calls `changeBg`.
 - C. Add a `dblclick` event to the green button that calls `changeBg`.
 - D. Add a `mousedown` event to the orange button that calls `changeBg`.
 - E. Add a `mouseup` event to the orange button that calls `changeBgWhite`.
 - F. Add a `mouseover` event to the link that calls `changeBg`.
 - G. Add a `mouseout` event to the link that calls `changeBgWhite`.
 - H. Add a `keyup` event to the `document` object that calls `changeBgWhite`.
3. Write the `changeBg()` function.

Challenge

1. Change the `changeBgWhite()` function as follows:

```
function changeBgWhite(e) {  
    changeBg('white');  
}
```

2. Change the `changeBg()` function to allow for a color value as a string as well as an event. If an event is passed in, it should get the color from the `id` of the `currentTarget` of the event as it does now. But if a string is passed in, it should use that string as the color value.

Solution: EventHandlers/Solutions/add-event-listener.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9.   function changeBg(e) {
10.     const color = e.currentTarget.id;
11.     document.body.style.backgroundColor = color;
12.   }
13.
14.   function changeBgWhite(e) {
15.     document.body.style.backgroundColor = 'white';
16.   }
17.
18.   window.addEventListener('load', function() {
19.     const btnRed = document.getElementById('red');
20.     const btnGreen = document.getElementById('green');
21.     const btnOrange = document.getElementById('orange');
22.     const lnkPink = document.getElementById('pink');
23.
24.     btnRed.addEventListener('click', changeBg);
25.     btnGreen.addEventListener('dblclick', changeBg);
26.     btnOrange.addEventListener('mousedown', changeBg);
27.     btnOrange.addEventListener('mouseup', changeBgWhite);
28.     lnkPink.addEventListener('mouseover', changeBg);
29.     lnkPink.addEventListener('mouseout', changeBgWhite);
30.
31.     document.addEventListener('keyup', changeBgWhite);
32.   });
33. </script>
-----Lines 34 through 50 Omitted-----
```

Code Explanation

We need a `changeBgWhite()` function because we cannot key off the `id` value to change the background color to white for two reasons:

1. We have added two event handlers to the `btnOrange` button: `mousedown` and `mouseup`. For `mouseDown`, we call `changeBg()`, which keys off `btnOrange`'s `id` attribute ("orange") to change the background color to orange. For `mouseup` though, we want to change the background color to white, so we cannot call `changeBg()` again as that sets the color to the button's `id` value. That's why we need `changeBgWhite()`. The same logic applies to the `lnkPink` link.

-
2. The document object doesn't have an `id` value, so for `keyup` events, if we call `changeBg()`, the `e.currentTarget.id` value would be `null`. That's why we call `changeBgWhite()` instead.

Challenge Solution:

[EventHandlers/Solutions/add-event-listener-challenge.html](#)

```
-----Lines 1 through 7 Omitted-----  
8. <script>  
9.   function changeBg(colorOrEvent) {  
10.     let color = 'white'; // default  
11.     if ( typeof colorOrEvent === 'string' ) {  
12.       color = colorOrEvent;  
13.     } else {  
14.       color = colorOrEvent.currentTarget.id;  
15.     }  
16.     document.body.style.backgroundColor = color;  
17.   }  
18.  
19.   function changeBgWhite(e) {  
20.     changeBg('white');  
21.   }  
-----Lines 22 through 55 Omitted-----
```



*

16.5. Benefits of Event Listeners

Using on-event handlers such as `onclick` and `onmouseover` is simple and straightforward, while using event listeners requires more JavaScript to set things up, so why use event listeners?

There are at least two major benefits to using event listeners:

1. You can add multiple event listeners to the same element.
2. Your HTML and JavaScript code are decoupled, which provides for easier maintenance and debugging.

To illustrate, take a look at the following JavaScript file:

Demo 16.7: EventHandlers/Demos/benefits.js

```
1.  function color() {
2.    document.body.style.backgroundColor = 'red';
3.  }
4.
5.  function reset() {
6.    document.body.style.backgroundColor = 'white';
7.  }
8.
9.  function log(e) {
10.   const t = e.currentTarget;
11.   console.log(t.id + ' clicked');
12. }
13.
14. window.addEventListener('load', function() {
15.   const btnColor = document.getElementById('btn-color');
16.   btnColor.addEventListener('click', color);
17.   btnColor.addEventListener('click', log);
18.
19.   const btnReset = document.getElementById('btn-reset');
20.   btnReset.addEventListener('click', reset);
21.   btnReset.addEventListener('click', log);
22. });
```



Notice that you don't need to see the HTML to understand how this code will work and when it will run.

1. The `color()` and `reset()` functions just change the background color of the page.
2. The `log(e)` function logs the button click. Here we just log it to the console, but in practice, we could log it to a permanent location using Ajax, which we do not cover in this course.
3. Each button gets two event listeners: one to change the color and the other to log the event. We couldn't do this with an `onclick` tag without rewriting our JavaScript to combine the logging with the color-changing functions.

To see how it works, open `EventHandlers/Demos/event-listeners-benefits.html` in Google Chrome with the console open and click the buttons several times.



16.6. Timers

Timers are started and stopped with the following four methods of the `window` object:

1. `setTimeout(function, waitTime)` – `waitTime` is in milliseconds.
2. `clearTimeout(timer)`
3. `setInterval(function, intervalTime)` – `intervalTime` is in milliseconds.
4. `clearInterval(interval)`

Let's take a look at how `setTimeout()` and `clearTimeout()` work first:

Demo 16.8: EventHandlers/Demos/timer.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9.   // Create global timer variable
10.  let timer;
11.
12.  function changeBg(e) {
13.    const color = e.currentTarget.id;
14.    timer = setTimeout(function() {
15.      document.body.style.backgroundColor=color;
16.    }, 1000);
17.
18.
19.  function stopTimer() {
20.    clearTimeout(timer);
21.    alert('Timer cleared!');
22.  }
23.
24.  window.addEventListener('load', function() {
25.    btnRed = document.getElementById('red');
26.    btnWhite = document.getElementById('white');
27.    btnStop = document.getElementById('stop');
28.
29.    btnRed.addEventListener('click', changeBg);
30.    btnWhite.addEventListener('click', changeBg);
31.    btnStop.addEventListener('click', stopTimer);
32.  });
33. </script>
34. <title>Timer</title>
35. </head>
36. <body>
37. <main>
38.   <button id="red">Change Background to Red</button>
39.   <button id="white">Change Background to White</button>
40.   <button id="stop">Wait! Don't do it!</button>
41. </main>
42. </body>
43. </html>
```

Things to notice:

1. We make `timer` a global variable so that we can access the timer object from within multiple functions.

2. In the `changeBg()` function, we create the timer using `setTimeout()`. The first argument of `setTimeout()` is the function to execute and the second argument is the number of milliseconds to wait before executing it.
3. The `stopTimer()` function simply clears the timer using `clearTimeout()`.

The `setInterval()` and `clearInterval()` methods work the same way. The only difference is that the code gets executed repeatedly until the interval is cleared.

Demo 16.9: EventHandlers/Demos/interval.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9.   // Create global interval and color variables
10.  let interval;
11.  let color = 'white';
12.
13.  function startTogglingBg() {
14.    interval = setInterval(function() {
15.      if (color === 'white') {
16.        color = 'red';
17.      } else {
18.        color = 'white';
19.      }
20.      document.body.style.backgroundColor=color;
21.    }, 500);
22.  }
23.
24.  function stopTogglingBg() {
25.    clearInterval(interval);
26.  }
27.
28. window.addEventListener('load', function(){
29.   btnStart = document.getElementById('start');
30.   btnStop = document.getElementById('stop');
31.
32.   btnStart.addEventListener('click', startTogglingBg);
33.   btnStop.addEventListener('click', stopTogglingBg);
34. });
35. </script>
36. <title>Timer</title>
37. </head>
38. <body>
39. <main>
40.   <button id="start">Start</button>
41.   <button id="stop">Stop</button>
42. </main>
43. </body>
44. </html>
```

Open EventHandlers/Demos/interval.html in your browser to see how it works. Click the **Start** button. The background should change back and forth from red to white. Click the **Stop** button to stop the changes.

Exercise 25: Typing Test

 10 to 20 minutes

In this exercise, you will create a simple typing test.

innerHTML

This exercise uses the `innerHTML` property, which you can use to read and modify the HTML content of an element.

Here is the starting code:

Exercise Code 25.1: EventHandlers/Exercises/typing-test.html

```
-----Lines 1 through 7 Omitted-----  
8. <script>  
9.   // Global variable containing time passed  
10.  let timePassed = 0;  
11.  
12.  function checkSentence(sentence, entry) {  
13.    const msg = document.getElementById('message');  
14.    if (sentence === entry) {  
15.      msg.innerHTML = 'You finished in ' + timePassed + ' seconds';  
16.      return true;  
17.    }  
18.    timePassed += .1;  
19.    timePassed = parseFloat(timePassed.toFixed(1));  
20.    msg.innerHTML = timePassed + ' seconds';  
21.    return false;  
22.  }  
23.  
24.  window.addEventListener('load', function() {  
25.    const sentence = document.getElementById('sentence').innerHTML;  
26.    const entryField = document.getElementById('entry');  
27.  
28.    // Write your code here.  
29.  });  
30. </script>  
31. <title>Typing Test</title>  
32. </head>  
33. <body id="typing-test">  
34. <main>  
35.   <div id="container">  
36.     <p id="sentence">The quick brown fox jumps over the lazy dog.</p>  
37.     <input id="entry" placeholder="Click to start timer.">  
38.     <p id="message">0 seconds</p>  
39.   </div>  
40. </main>  
41. </body>  
42. </html>
```

Evaluation
Copy

-
1. Open EventHandlers/Exercises/typing-test.html in your editor.
 2. Beneath the line where entryField is declared, add an event listener to entryField, so that when the user focuses on the field, an interval is created. The interval's function should run every 100 milliseconds and should do the following:

- A. Call `checkSentence()`, passing in the sentence and the value of `entryField` and assigning the result to a variable.
 - B. If `checkSentence()` returns `true`, clear the interval.
3. Test your solution in a browser.

Solution: EventHandlers/Solutions/typing-test.html

```
-----Lines 1 through 7 Omitted-----
8. <script>
9.   // Global variable containing time passed
10.  let timePassed = 0;
11.
12.  function checkSentence(sentence, entry) {
13.    const msg = document.getElementById('message');
14.    if (sentence === entry) {
15.      msg.innerHTML = 'You finished in ' + timePassed + ' seconds';
16.      return true;
17.    }
18.    timePassed += .1;
19.    timePassed = parseFloat(timePassed.toFixed(1));
20.    msg.innerHTML = timePassed + ' seconds';
21.    return false;
22.  }
23.
24. window.addEventListener('load', function() {
25.   const sentence = document.getElementById('sentence').innerHTML;
26.   const entryField = document.getElementById('entry');
27.
28.   entryField.addEventListener('focus', function() {
29.     const interval = setInterval(function() {
30.       const result = checkSentence(sentence, entryField.value);
31.       if (result) {
32.         clearInterval(interval);
33.       }
34.     }, 100);
35.   });
36. });
37. </script>
-----Lines 38 through 49 Omitted-----
```

Conclusion

In this lesson, you have learned:

- How to use on-event handlers to respond to user events.
- How to listen for events with the `addEventListener()` method and to understand the benefits of this approach.
- How to write anonymous functions.

- How to create timers and intervals.

evaluator
by