

1.1 Web history

Internet and web

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Computers of the 1940s and 1950s were mostly solitary machines, but in the 1960s computer networks evolved. A computer network allows computers to communicate information with each other. The **Internet** began as four networked computers in 1969 but is today the largest and most popular computer network, spanning the entire globe. Early versions of the Internet looked and acted similar to today, but in a much simpler way. Documents were plain text: no images, no formatting, and no interaction. **FTP (File Transfer Protocol)** was an early way for transferring files over the Internet. Users used FTP programs to connect to servers, look at listings of available documents, and download documents of interest.

Figure 1.1.1: NASA public FTP site.

Name	Size	Date Modified
[parent directory]		
00readme.txt	2.4 kB	5/9/05, 12:00:00 AM
aaa_planetary_data_at_nssdcftp.gsfc.nasa.gov.html	531 B	9/16/15, 12:00:00 AM
galileo_update.txt	1.4 kB	2/24/99, 12:00:00 AM
traj/		2/12/99, 12:00:00 AM

In the early 1990s, Tim Berners-Lee was working at a Swiss research institute named CERN and developed a more convenient way for computers to communicate files over the Internet. Berners-Lee named his creation the **World Wide Web**, or simply "the **web**". The web involved three things:

1. Text files, known as HTML files, containing *links* to other text files.
2. A program, known as a browser, for viewing HTML files.
3. A set of rules, known as the HTTP protocol, for transferring HTML files among computers.

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1.1.1: The web uses HTML files, web browsers, and HTTP to provide a more convenient way for computers to communicate on the web.

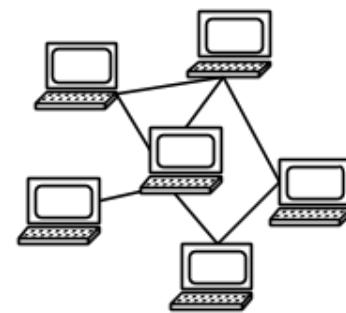


Animation captions:

1. FTP is used to transfer files by logging into a computer with the files and typing commands to get the desired files.
2. HTTP is a protocol for transferring HTML files among computers. Files can contain links to other files.
3. Clicking a link in a file opens the file being linked to. Files can contain multiple links.

The web was originally called the World Wide Web, or WWW, because Berners-Lee envisioned a large collection of globally distributed web pages linking to each other. A **web page** is a document that is viewed in a web browser. A collection of related web pages are organized into a **website** and stored on a web server. A **web server** is a computer (or software running on a computer) that serves web pages to web browsers.

Figure 1.1.2: The web's name comes from the interconnections of computers being like the interconnections of a spider's web.



Source: Spider web ([Steve Gibson](#) / Public Domain), computer network (zyBooks)

Introduction of HTML

HyperText markup language (HTML) is the standard markup language for web documents. **Hypertext** is text that has links to other text (and today to images, videos, and more). Document **markup** is special markings in the document that provide additional information about links, formatting, and images. HTML also permits adding metadata like search engine keywords, author information, and language.

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Figure 1.1.3: One of the first web pages.

World Wide Web

The WorldWideWeb (W3) is a wide-area [hypermedia](#) information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an [executive summary](#) of the project, [Mailing lists](#), [Policy](#), November's [W3 news](#), [Frequently Asked Questions](#).

[What's out there?](#)

Pointers to the world's online information, [subjects](#), [W3 servers](#), etc.

[Help](#)

on the browser you are using

[Software Products](#)

A list of W3 project components and their current state. (e.g. [Line Mode](#), [X11 Viola](#), [NeXTStep](#), [Servers](#), [Tools](#),

[Mail robot](#), [Library](#))

[Technical](#)

Details of protocols, formats, program internals etc

[Bibliography](#)

Paper documentation on W3 and references.

[People](#)

A list of some people involved in the project.

[History](#)

A summary of the history of the project.

[How can I help?](#)

If you would like to support the web..

[Getting code](#)

Getting the code by [anonymous FTP](#), etc.

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FROM: W3.ORG

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1.1.2: The web.

web server website HTML Early 1990s HTTP Browser

Information mesh web page

The period when the web was first developed.

The language used for a text file that describes a web page.

Web document that is viewed in a web browser.

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Software that serves web pages to browsers.

The protocol for transferring files among computers via the web.

A program for viewing web pages.

Another name for the web that was considered by the web's creator.

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Today, most but not all Internet traffic is web traffic. People thus have a hard time distinguishing the Internet (the interconnection of computers communicating using a set of rules), and the Web (which is just one particular use of the Internet).

Table 1.1.1: Number of websites per year.

The number of websites has grown at a dramatically fast rate.

Year	Websites	Internet users	Major websites launched
2015	863,105,652	3,185,996,155	
2014	968,882,453	2,925,249,355	
2013	672,985,183	2,756,198,420	
2012	697,089,489	2,518,453,530	
2011	346,004,403	2,282,955,130	Twitch
2010	206,956,723	2,045,865,660	Pinterest, Instagram
2009	238,027,855	1,766,206,240	
2008	172,338,726	1,571,601,630	Dropbox
2007	121,892,559	1,373,327,790	Tumblr
2006	85,507,314	1,160,335,280	Twitter
2005	64,780,617	1,027,580,990	YouTube, Reddit
2004	51,611,646	910,060,180	Facebook, Flickr
2003	40,912,332	778,555,680	WordPress, LinkedIn
2002	38,760,373	662,663,600	
2001	29,254,370	500,609,240	Wikipedia

2000	17,087,182	413,425,190	
1999	3,177,453	280,866,670	PayPal
1998	2,410,067	188,023,930	Google
1997	1,117,255	120,758,310	eBay, Netflix
1996	257,601	77,433,860	©zyBooks 02/27/19 21:58 458368 jingya xun SANDIEGOCOMP494GappySpring2019
1995	23,500	44,838,900	Altavista, Amazon
1994	2,738	25,454,590	Yahoo!
1993	130	14,161,570	
1992	10		
8/1/91	1		

Source: [InternetLiveStats, 2016](#).

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1.1.3: Websites per year.



Refer to the above table.

1) When was the first website published?



- 1991
- 2001

2) When was Yahoo created?



- 1994
- 2001

3) How many websites existed in 2001?



- Thousands
- 30 million

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4) How many websites existed in 2011?



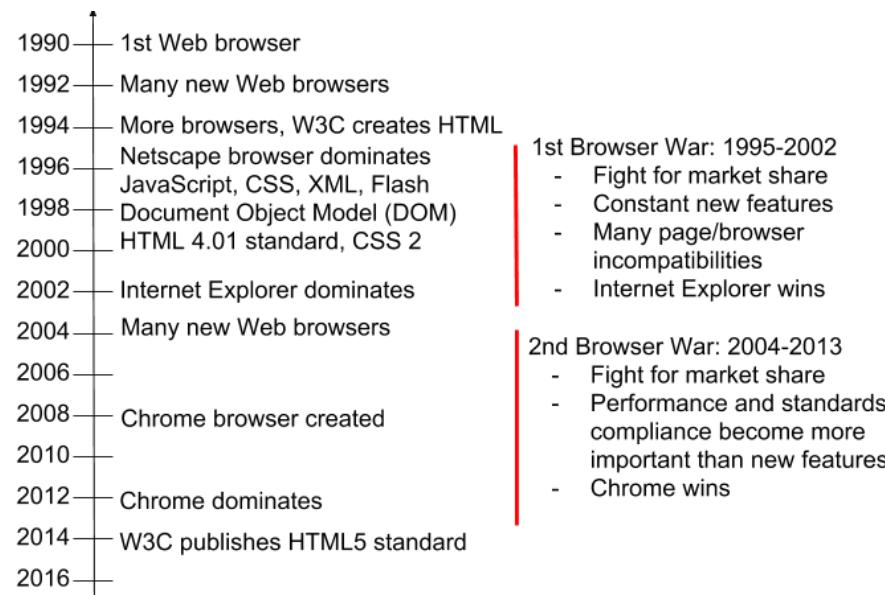
- 350 million
- 350 trillion

Browser wars

A **web browser** is a program that downloads an HTML document from a server, displays the document to the user with the appropriate formatting, and allows the user to interact with the document, such as clicking hyperlinks to access other documents. A web browser uses HTML to understand the structure and semantics, or meaning, of the document.

Early in browser history, browser developers competed for users by trying to provide the best web browsing experience. Ex: Browser developers added enhancements allowing greater interactivity in web documents. These enhancements only worked within specific browsers, so many documents could not be viewed properly on all browsers.

Figure 1.1.4: Web browser timeline.



HTML standardization

The frequent web page and browser incompatibility headaches pushed the industry to value standardization. **W3C** (the World Wide Web Consortium) is the international standards organization that controls web standards. HTML5 is the current HTML standard and was standardized in 2014. An HTML5 valid web page will look and act the same way in any web browser that follows HTML5 rules. With standardization, browser developers now compete on browser speed, standards compliance, and browser features rather than on the basis of proprietary extensions.

Note

HTML5 or HTML 5? W3C always uses the name HTML5 instead of HTML 5 when referring to the 5th version of HTML standard.

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1.1.4: Significant points in web history.

2014

1995

1994

1945

1990

1965

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The idea for generating links from within one document to other documents.

The term HyperText invented.

First web browser is created.

The World Wide Web Consortium (W3C) created.

HTML 2.0 standard published.

HTML5 standard published.

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A significant change that occurred over time was a move to separate document structure, document presentation (how the document is displayed in a browser), and web page interaction with the user. Document markup was initially used to control both document structure and appearance. Some markup, such as the tag , was originally used just to control appearance. Interlacing document structure with presentation and interaction complicates having pages work well across the range of technologies from large screens, to small phones, to printing devices.

HTML5 standard uses HTML, CSS, and JavaScript to create a web page. HTML defines the structure and content of a web page. CSS specifies the layout and visible appearance. JavaScript describes the dynamic behaviors and actions of a web page.

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1.1.5: Separation of structure, presentation, and interaction.

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DOM**JavaScript****HTML****CSS**

Specifies document structure

Manages document presentation

Enables document interaction

Document Object Model

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Great example

CSS Zen Garden is a website where each page consists of exactly the same HTML and text, but different CSS is used to make the pages look totally different.

Exploring further:

- [W3C Web and Internet History Timeline](#)
- [Browser wars history \(Wikipedia\)](#)
- [History of the World Wide Web \(Wikipedia\)](#)

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1.2 IP addresses, domain names, and URLs

An **IP address** (short for **Internet Protocol** address) is a computer's unique address on the Internet (like a house's unique address in the world), usually represented numerically like 198.51.100.7. A typical IP address is 32 bits, divided into four 8-bit groups, each group often written as a decimal number.

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1.2.1: IP addresses.

Animation captions:

1. An IP address is usually written as four numbers separated by dots.
2. Each number represents 8 bits of the IP address, for a total of 32 bits.
3. A DNS (Domain Name System) server converts a domain name like cnn.com to an IP address.

All websites could be reached by the computer system's IP address. Ex: The news company CNN could say "Go to 157.166.226.25 for the latest world news." But those numbers are hard to remember, so domain names are also used. A **domain name** is a name for an IP address, such as the name wikipedia.org for the IP address 208.80.154.224; the name is easier to remember and type. Capitalization doesn't matter: Wikipedia.org, wikipedia.org, and WIKIPEDIA.ORG are treated the same. When a computer sends a packet using a domain name over the Internet, the first step is to contact a **DNS server** to convert the domain name to an IP address. **DNS** is short for Domain Name System.

Figure 1.2.1: Typing 157.166.226.25 into a web browser leads to CNN's website, but a domain name like cnn.com is easier to remember.



Thirteen main DNS servers (called **root servers**) exist in the world, and a computer's operating system or an ISP keeps a reference to the root servers' IP addresses. Ex: 198.41.0.4 (run by Verisign), 192.228.79.201 (run by USC), 199.7.91.13 (run by Univ. of Maryland), and 192.203.230.10 (run by NASA). The first step of sending an Internet packet to a domain name is thus to lookup the IP address via a DNS server.

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1.2.2: A DNS server first looks up a domain name's IP address.

Animation captions:

1. A computer wants to send a packet to cnn.com.
2. First, a packet is sent to a DNS server to lookup the IP address.
3. The packet contains the destination address. The computer can now communicate with CNN.

Above, a PC requested a web page from cnn.com. The packet included the destination IP address (for cnn.com), and also the "From" address (of the PC) so that CNN's web server knows to where to send the requested web page.

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1.2.3: IP addresses and domain names.



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- 1) Websites have either an IP address or a domain name, but not both.

- True
- False

- 2) cnn.com is a(n) ____.

- IP address
- domain name
- DNS

- 3) A DNS server's primary role is to convert _____.



- an IP address into 32 bits
- an IP address to a domain name
- the domain name to an IP address

Try 1.2.1: IP addresses and domain names.

Several sites will lookup the IP address of a domain, such as the following.

- Click to open www.site24x7.com. Type "Wikipedia.com" or your favorite website name.

Given an IP address, some sites will indicate the geographic location of that IP address' computer.

Try entering 171.67.215.200, which is Stanford.com's IP address, whose computers are in Palo Alto, California.

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- Click to open www.iplocation.net.

Typing "What is my IP?" in a search engine can be used to determine one's IP address.

- Click to open Google.com.
- Click to open Bing.com.

The original Internet Protocol, known as **IPv4**, has 32-bit addresses. 32 bits can represent 2^{32} or about 4 billion unique addresses, originally believed to be more than would ever be needed; But 4 billion is no longer enough. A new version of the Internet Protocol, **IPv6**, uses 128-bit addresses, capable of representing 2^{128} addresses. That number is or 3.4×10^{38} or 340,000,000,000,000,000,000,000,000,000 hopefully enough for quite a while. IPv4 and IPv6 currently co-exist, and likely will for a long time.

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PARTICIPATION
ACTIVITY 1.2.4: Internet protocol.

1) What is the size of an IP address in IPv4?

- 32 bits
- 128 bits



2) IPv6 supports about how many IP addresses?

- 100 billion
- 3.4×10^{38}



3) With the introduction of IPv6, devices on the Internet no longer use IPv4.

- True
- False



Domain names are hierarchical. A domain name belongs to one of numerous **top-level domains (TLD)**, such as .com, .net, .org, .edu, and .gov. Also, each country is assigned a unique two-letter **country code top-level domain (ccTLD)** like .uk (United Kingdom), .ru (Russia), and .de (Germany). **ICANN**, the organization that manages TLDs, now allows companies and organizations to create customized TLDs, like .church, .pizza, and .music.

PARTICIPATION
ACTIVITY 1.2.5: Common top-level domains.

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Animation captions:

1. Internet domain names are divided by top-level domains.
2. The most popular is .com. Most companies have a .com name.
3. Next most popular is .net. Typically for networking/Internet-focused companies.
4. Next is .org, traditionally for non-profit organizations.

5. Other well-known top-level domains are .edu for colleges, and .gov for U.S. governments. Hundreds more exist.

Immediately after a top-level domain comes a **second-level domain**, such as wikipedia in wikipedia.org. A second-level domain is commonly an organization's name as in Stanford.edu, or indicates the purpose of a website as in DoPython.org. Third-level and further level domains refer to sub-computer systems local to an organization, as in cs.stanford.edu where the cs is for Stanford's Computer Science department. A common third-or-deeper-level domain is www, short for World Wide Web, usually referring to an organization's web server. Many organizations use www optionally, so stanford.edu by default goes to www.stanford.edu.

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1.2.6: Domain hierarchy.



Given a website such as www.whitehouse.gov, match the domain to the corresponding domain-level hierarchy.

.gov whitehouse www

Top-level domain.

Third-level domain

Second-level domain.

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Note

The top-down structure of a domain name is, somewhat counterintuitively, from right-to-left rather than left-to-right. Thus, cs.stanford.edu has a top-level domain of .edu, second-level stanford, and third-level cs. Common scams use this counterintuitive right-to-left feature to trick people into thinking a site belongs to a particular company. Ex: bankofamerica.xxyz.com might trick a person into thinking the domain name is for Bank of America.

Domain names are most commonly seen in URLs. A **URL (Uniform Resource Locator)** is the location of a web resource on the web, such as <http://www.cdc.gov/alcohol/faqs.htm>. A **web resource** is any retrievable item, like an HTML file, image, video, CSS style sheet, etc.

A URL is composed of several parts:

- **Scheme** - Characters at the beginning of a URL followed by a colon ":" or a colon and double slashes "://". Common URL schemes include **http**, **https**, **mailto**, and **file**. Ex: In <http://www.cdc.gov/alcohol>, the scheme is "http".
- **Hostname** - The complete domain name specified in the URL. Ex: In <http://www.cdc.gov/alcohol>, the hostname is "www.cdc.gov".
- **Path** - All characters to the right of the hostname in the URL. Ex: In <http://www.cdc.gov/alcohol>, the path is "/alcohol".

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URLs sometimes have special characters for giving the web server more information. Ex: In <https://www.youtube.com/watch?v=uu7XCEMdSHg>, the ? tells YouTube's server to play a video having code uu7XCEMdSHg (technically, the part after the ? provides a "parameter"). A web user usually need not worry about such technical details.

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1.2.7: A URL can specify the location of subfolders and files.



Animation captions:

1. A computer sends a packet requesting information from a web server at www.cdc.gov.
2. The information is in a subfolder named alcohol, then in a file in that folder named faqs.html.
3. The faqs.htm file is returned and displayed on the computer.

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1.2.8: URLs.



1) Is the following a valid URL?



<http://www.whitehouse.gov/>

- Yes
 No

2) Is the following a valid URL?



http://www.nasa.gov/cubequest/details/#.VOaO_VPF9U9 ©zyBooks 02/27/19 21:58 458368
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- Yes
 No

3) What is the hostname of the following URL?



<http://www.weather.com/summer/temperatures.htm>

- www.weather.com

weather.com

- 4) Which file does the following URL access?

http://www.weather.com/summer/temperatures.htm

summer

temperatures.htm

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- 5) Which scheme should a URL use to provide a secured HTTP connection to a web server?

http

https

- 6) Is www.nasa.gov a valid URL?

Yes

No



Registering a domain name

Anyone may register an unused domain name with a **domain name registrar**. Most registrars charge a yearly fee for keeping the domain registered. Once a domain name is registered, the owner's name, address, and other registration information is made publicly available from ICANN's [Whois](#) service.

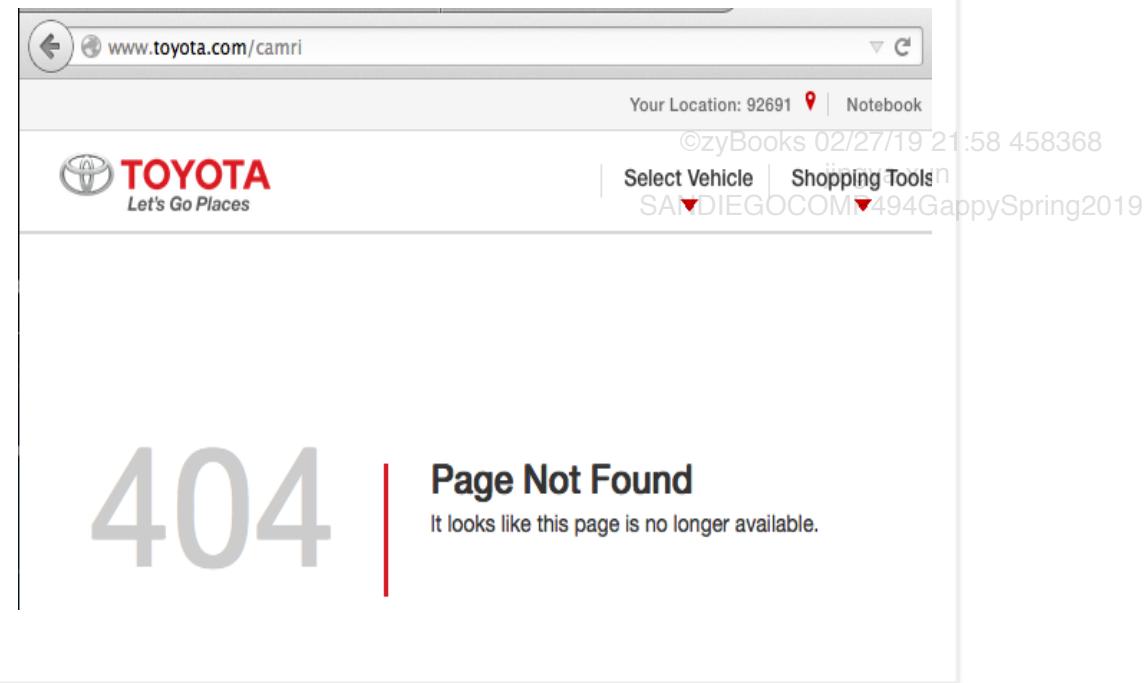
When a website is hosted with a web hosting company, the company will update the DNS root servers so the website's domain name is associated with the IP address of the hosted website. The web hosting company may also manage the yearly registration of the domain name.

If a domain name is not found by a DNS server (usually because the domain name is not registered), a page is displayed indicating such, as in "Sorry, the website www.xyz.blahblahblah cannot be found."

A domain name may be found (so a valid IP address exists for that name) but the web server may not respond, resulting in a message like "The website is not responding" or "Could not reach the website". Such non-response could be due to the web server being turned off or undergoing maintenance, or due to an essential router malfunctioning, for example.

If a web server is reached but the specific requested page isn't found, the server returns a **404** error message, which is a code number for page not found. Various other codes exist. Many web servers return a page that includes the number "404".

Figure 1.2.2: An example web page that returns a message with the code 404 shown.



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1.2.9: Web page errors.

1) A 404 message indicates that a domain name is not recognized.

- True
 False

2) If a web server is down (such as powered off), the server may return a page saying to please try again later.

- True
 False

Exploring further:

- URL - uniform resource locator
- Domain name
- Top-level domain
- List of top-level domains

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1.3 HTTP

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Introduction to HTTP

The **HyperText Transfer Protocol (HTTP)** is a networking protocol that runs over TCP/IP and governs communication between web browsers and web servers. **Transmission Control Protocol/Internet Protocol (TCP/IP)** is a protocol suite that governs how packets of data are transferred over the Internet from one machine to another. Understanding the details of TCP/IP is not usually required of web developers, but a thorough understanding of HTTP is necessary to create effective web applications.

Before HTTP communication begins, the web browser extracts the domain name from the URL being accessed and performs a DNS lookup. The web browser performs a **DNS lookup** by sending the domain name to the local DNS and getting back the IP address of the web server hosting the domain name. Ex: <https://www.w3c.org/> has a domain name of www.w3c.org, and DNS translates www.w3c.org to the IP address 128.30.52.45. The web browser uses the IP address to establish a TCP connection with the web server and begins communicating with HTTP.

HTTP functions as a request-response protocol between web browsers and web servers:

- An **HTTP request** is a message sent from the web browser to the web server. Often the request asks the web server to send back a web resource like an HTML file, image, CSS style sheet, JavaScript file, or video.
- An **HTTP response** is a message sent from the web server back to the web browser in response to an HTTP request. Often the response contains the requested web resource.

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1.3.1: HTTP requests and responses.



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Animation captions:

1. Web browser does a DNS lookup of the domain name and makes a TCP connection.
2. HTTP request is made asking for resource at <http://w3c.org/test.html>.
3. Web server locates test.html file and sends the contents of test.html to the browser.
4. Browser parses HTML and makes second request for <http://w3c.org/field.jpg>.
5. Web server locates field.jpg and sends the image to the browser. The browser then displays the field.jpg image.

6. No more resources to request, so TCP connection is closed.

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1.3.2: HTTP requests and responses.



1) Before a TCP connection is created, the web browser performs a/an _____.

- HTTP request
- HTTP response
- DNS lookup

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2) How many total HTTP requests does a browser send for a web page that does not use any other web resources?

- 1
- 2
- 3



3) How many total HTTP requests does a browser send for a web page that contains four web resources: an image, a video, a CSS style sheet, and a JavaScript file?

- 1
- 4
- 5



4) If a web browser sends 20 HTTP requests to a web server, how many HTTP responses will the web server send to the web browser?

- 0
- 10
- 20

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Request and response headers

An HTTP request and an HTTP response are both composed of four parts:

1. Status line

2. Zero or more header fields
3. Empty line
4. Optional message body

The web server is able to identify the requested resource from the path in the status line. The web server sends back the requested resource in the message body of the response.

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Figure 1.3.1: HTTP request with no message body: Web browser requesting Wikipedia page about the World Wide Web.

Request for URL: https://en.wikipedia.org/wiki/World_Wide_Web

```
GET /wiki/World_Wide_Web HTTP/1.1
Host: en.wikipedia.org
User-Agent: Mozilla/5.0 Chrome/48.0.2564
```



Figure 1.3.2: HTTP response: Web server sending web browser the Wikipedia page about the World Wide Web.

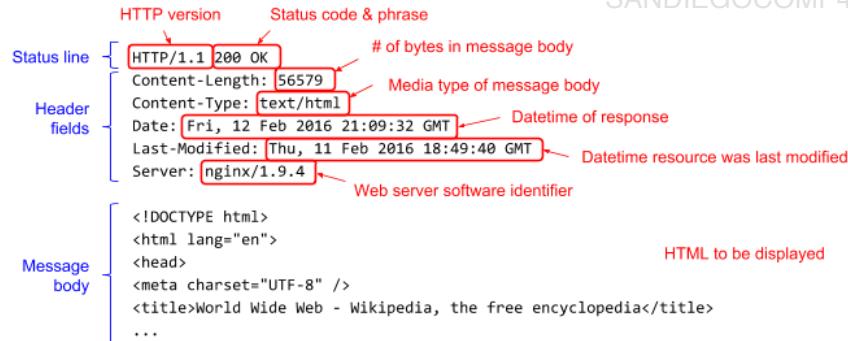
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Response for URL: https://en.wikipedia.org/wiki/World_Wide_Web

```
HTTP/1.1 200 OK
Content-Length: 56579
Content-Type: text/html
Date: Fri, 12 Feb 2016 21:09:32 GMT
Last-Modified: Thu, 11 Feb 2016 18:49:40 GMT
Server: nginx/1.9.4
```

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8" />
<title>World Wide Web - Wikipedia, the free encyclopedia</title>
...

```



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1.3.3: HTTP request and response headers.

Date	User-Agent	Server	Content-Length	Last-Modified	Content-Type
------	------------	--------	----------------	---------------	--------------

Host

Number of bytes in the response's message body.

Media type of the response's message body.

Datetime the response was generated by the web server.

Datetime the requested resource was last modified on the web server.

Identifies the web server software that generated the response.

The domain name for the requested path.

Identifies the browser making the request.

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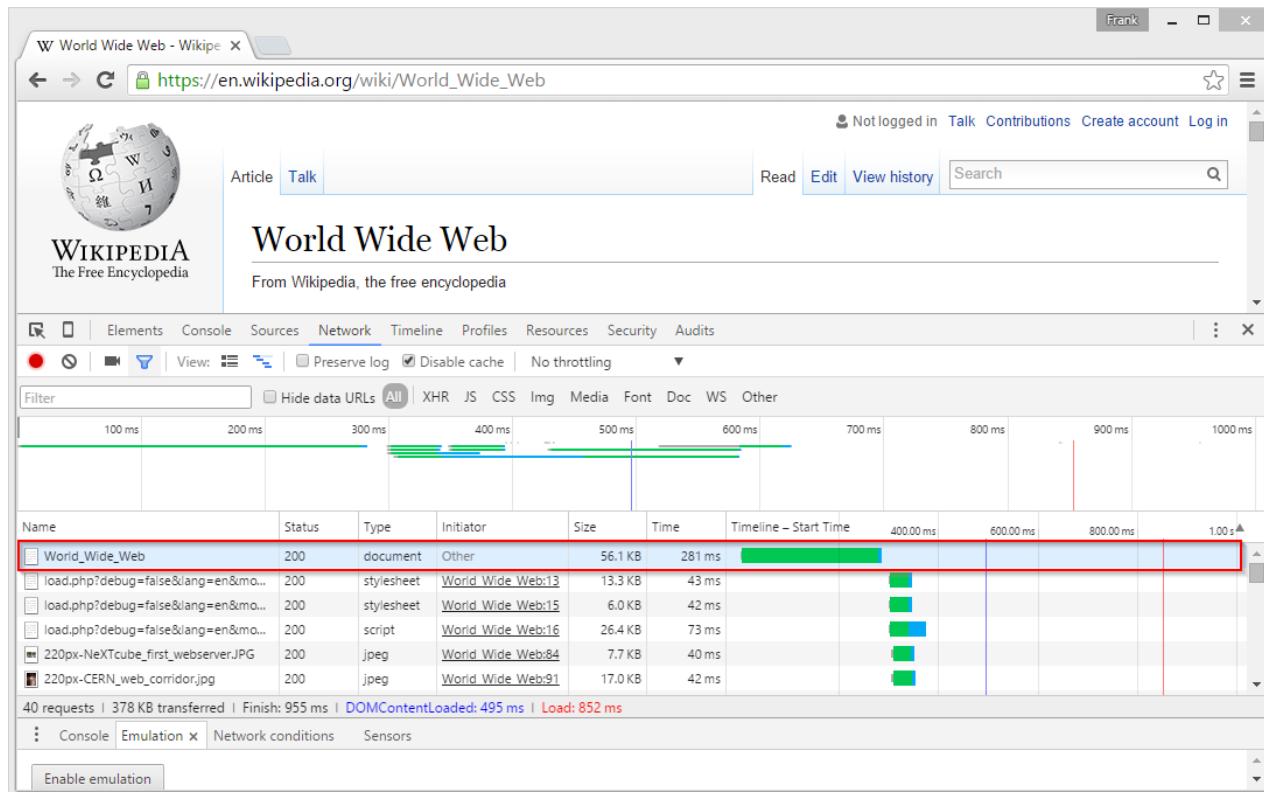
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Chrome DevTools for watching HTTP traffic.

All popular web browsers contain built-in developer tools. Developers can access Chrome's developer tools (DevTools) by pressing *Ctrl+Shift+I* (Windows) or *Command-Option-I* (Mac). In the figure below, the Network tab shows the HTTP network traffic when accessing Wikipedia's article on *World Wide Web*. The first HTTP request is highlighted. All subsequent requests are for other resources used in the web page. When a developer clicks on a specific request, the details of that request-response are displayed.



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The screenshot shows a browser developer tools Network tab. On the left, there's a list of network requests. One request is expanded, showing its details. The expanded request is for 'World_Wide_Web' and has a status of 200 OK. The Headers panel on the right shows the following response headers:

- Accept-Ranges: bytes
- Age: 0
- Backend-Timing: D=126583 t=1455308170199859 jingya xun
- Cache-Control: private, s-maxage=0, max-age=0, must-revalidate
- Connection: keep-alive
- Content-Encoding: gzip
- Content-Language: en

Request methods and response status codes

The most common HTTP request-response scenario is when the web browser issues a request with the GET request method, and the web server returns the requested resource with a 200 status code. An HTTP **request method** indicates the desired action to perform on a resource. Other request methods besides GET may also be sent in an HTTP request. Ex: POST is often used when the web browser is sending information from a web form to the web server. The POST, PUT, and DELETE request methods are used by web services that allow new resources to be created, modified, and deleted on the web server.

Table 1.3.1: Common HTTP request methods.

Request method	Meaning
GET	Request a representation of the specified resource.
HEAD	Request a response identical to GET but without the response body.
POST	Request the web server accept the message body enclosed in the request as a new resource.
PUT	Request the web server accept the message body enclosed in the request as a modification of an existing resource.
DELETE	Request the web server delete the existing resource.

An HTTP response **status code** is a three digit number that indicates the status of the requested resource. A successfully requested resource results in a 200 status code, and other status codes are returned for various reasons. Ex: A 301 or 302 status code redirects the browser to a

different URL. A **browser redirect** is when the web server returns a 301 or 302 status code with a **Location** header indicating the URL the browser should load next.

Table 1.3.2: Common HTTP response status codes.

Status code	Status phrase	Meaning
200	OK	Standard response for a successful request.
301	Moved Permanently	The resource should always be requested at a different URL.
302	Found	The resource should temporarily be requested at a different URL.
304	Not Modified	The resource has not been modified since the last time the resource was requested.
403	Forbidden	The web server does not have permission to access the resource.
404	Not Found	The resource could not be located.
500	Internal Server Error	Something unexpected happened on the web server.

URL shortening

URL shortening is a technique to create shorter URLs that redirect to longer URLs. Ex:

http://en.wikipedia.org/wiki/URL_shortening has a short URL of <http://tinyurl.com/urlwiki>.

Short URLs are convenient for sharing on social media, especially on Twitter where the number of characters in a post is limited. Common URL shortening services include bit.ly, goo.gl, and tinyurl.com.

When a user types or clicks on a short URL, the URL shortening service responds with a 301 status code and a Location header with the web page's full URL. An example HTTP request and response is shown below that redirects <http://tinyurl.com/urlwiki> to http://en.wikipedia.org/wiki/URL_shortening.

HTTP request	HTTP response
<pre>GET /urlwiki HTTP/1.1 Host: tinyurl.com User-Agent: Mozilla/5.0 Chrome/48.0.2564</pre>	<pre>HTTP/1.1 301 Moved Permanently Date: Tue, 16 Feb 2016 16:38:59 GMT Location: http://en.wikipedia.org/wiki/URL_shortening</pre>

**PARTICIPATION
ACTIVITY**

1.3.4: HTTP request methods and response status codes.



1) Which request method is used by the browser to get the same response headers that a GET would generate but without the message body?

- GET
- HEAD
- PUT

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2) Which request method is used by the browser to submit web form data to the web server?

- GET
- PUT
- POST



3) Which status code is sent when the web server wants to redirect the browser to a different URL?

- 200
- 301 or 302
- 403



4) Which status code is sent when the requested URL does not point to an existing resource on the web server?

- 200
- 301
- 404



5) Which status code is sent when the web server is denied permission to the requested URL?

- 301
- 304
- 403

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Linkrot

The web is always changing with new content being added and removed at all hours of the day. When content is removed from the web, URLs that used to point to the content return the 404 status code. **Linkrot** is the general name for once valid links that now return 404 status codes.

The [Internet Archive](#) is one of many organizations around the world that fights linkrot by ⁶⁸ archiving the Web for posterity. The Internet Archive's [Wayback Machine](#) can often show users what a particular URL looked like at different times in history. The Wayback Machine currently provides access to over 466 billion archived web pages.

Browser caching

Most web browsers use a browser cache to store requested content. A **browser cache** is an area on the computer's disk where web content can be stored by the web browser for quick retrieval later. By caching web content, browsers can reduce the amount of network traffic required to display previously visited web pages. Ex: If a web page is accessed now and again 10 minutes from now, the browser can display the cached web page instead of re-downloading the web page. However, a news web page is likely to have changed in a 10 minute span, so the browser should not display cached content if the web page has changed.

Web browsers often use ETags to aid in caching web resources. An **entity tag (ETag)** is an identifier for a specific version of a web resource. Ex: 34905a3e285dd11. When the resource changes, so should the ETag associated with the resource. When a web browser requests a cached web resource, the browser sends the ETag in the request with an **If-None-Match** header. The web server will reply with a 304 Not Modified response status if the resource has not changed or a 200 OK with the changed resource and a new ETag.

PARTICIPATION
ACTIVITY

1.3.5: Requesting cached resources with ETags.



Animation captions:

1. HTTP request is made for uncached resource at <http://w3c.org/test.html>.
2. Web server locates test.html file and sends the contents of test.html back to the browser where test.html is cached.
3. Second request made for cached test.html includes the ETag 123abc.
4. Web server compares ETags and notes the file has not changed, so 304 is returned with no HTML. The browser displays the cached content.
5. test.html is modified on the web server and assigned a new ETag.
6. Browser makes third request for test.html with ETag 123abc.
7. Web server compares ETags and notes the file has changed, so 200 is returned with new HTML and ETag.

8. Browser displays new content and updates the browser cache.

PARTICIPATION
ACTIVITY

1.3.6: Requesting cached content.



- 1) Which status code is sent when the web server compares the cached ETag with the server's ETag for a requested web resource, and the two ETags are identical?

- 200
- 304
- 403



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- 2) Does a 304 response generally contain a message body?

- Yes
- No



- 3) Do web servers always generate ETags for all web resources?

- Yes
- No



- 4) Where can the HTTP header field **If-None-Match** be found?

- HTTP request
- HTTP response



- 5) What HTTP header field is used to make a conditional request using a datetime?

- If-None-Match
- Last-Modified
- If-Modified-Since

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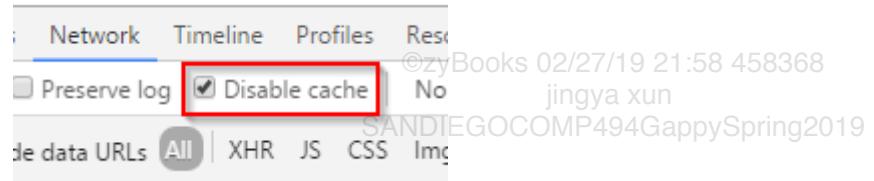
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Viewing 304 responses in Chrome DevTools

Web developers can view 304 Not Modified responses in Chrome's DevTools by opening the Network tab and ensuring the checkbox labeled "Disable cache" is not checked. If "Disable

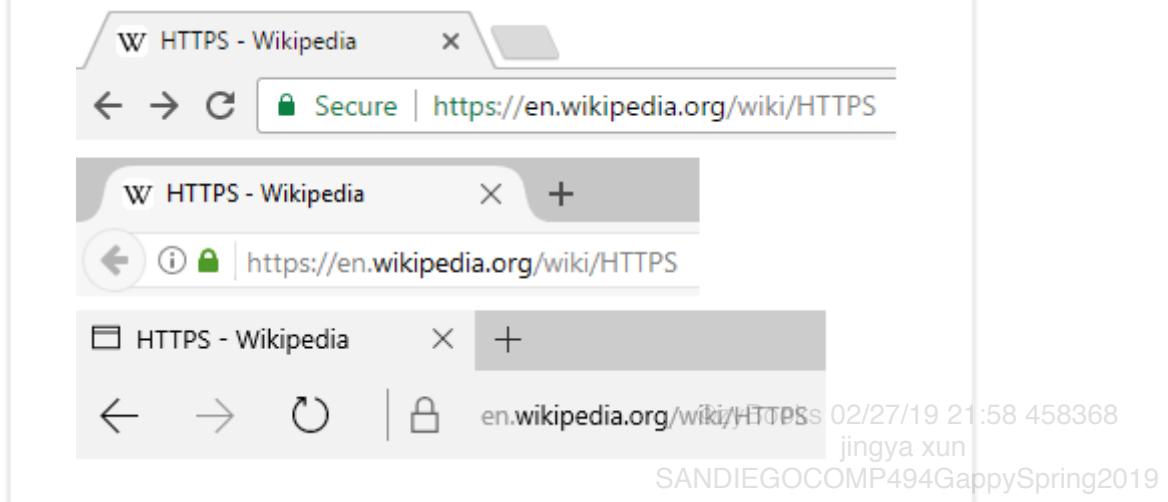
"cache" is checked then nothing will be cached, and ***If-None-Match*** and ***If-Modified-Since*** headers will not be sent. The W3C page defining the **HTTP Header Fields** is a good page to test in DevTools to see 304 responses. When the developer loads the page once, the 200 status code will be returned by the web server. When the developer presses the Reload button, a 304 status will be returned.



HTTPS

All HTTP traffic can be viewed by third parties using a network sniffer. A **network sniffer** is software that monitors network traffic and allows users to inspect HTTP requests and responses. **HTTPS** is a protocol that encrypts HTTP traffic between a browser and web server so a network sniffer cannot intercept sensitive information in the HTTP traffic like passwords, credit card numbers, financial transactions, etc. A website wanting to use HTTPS must acquire a **digital certificate** issued by a trusted **certificate authority**, which contains a public key needed to encrypt data between the browser and web server.

Figure 1.3.3: Chrome, Firefox, and Edge browsers showing a padlock symbol when HTTPS is used.



PARTICIPATION
ACTIVITY

1.3.7: Steps in an HTTPS transaction.

Identify the steps used in an HTTPS transaction.

The browser and web server initiate an "SSL handshake".

Browser requests an HTTPS connection to a web page.

Web server sends digital certificate to the browser.

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The browser and web server transmit encrypted information.

Step 1

Step 2

Step 3

Step 4

Reset

Exploring further:

- Anatomy of an HTTP Transaction
- List of HTTP status codes on Wikipedia
- HTTP ETag on Wikipedia
- HTTPS on Wikipedia
- Chrome DevTools Network panel overview

How was this section?



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1.4 Web trends

Web technology is changing so fast, that predicting how web tools and behaviors will have changed, even a few years from now, is very challenging. However, some significant trends exist and are important for web developers to consider.

Making predictions

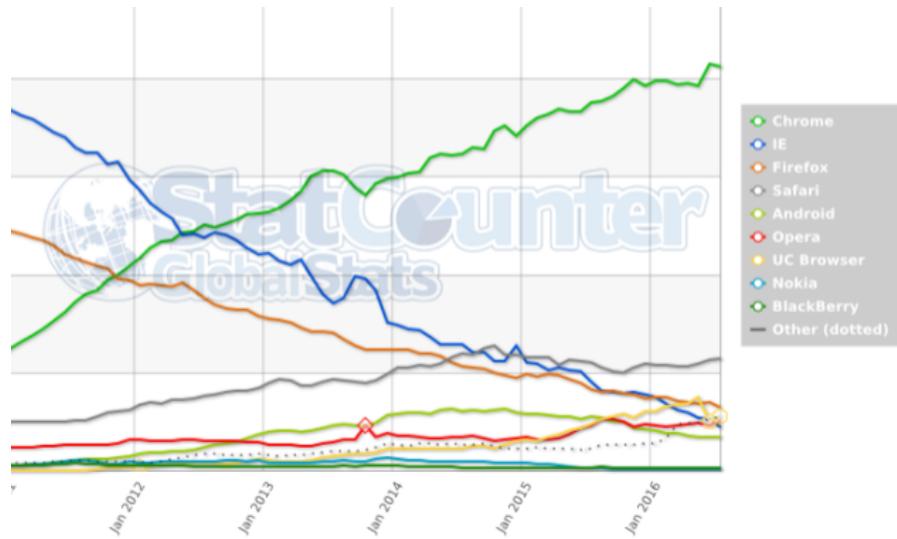
Yogi Berra, the famous baseball player and manager, joked "It's tough to make predictions, especially about the future."

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Web browser market share continues to change

The relative usage of various browsers changes continually. Web applications that depend on a particular browser to function correctly can be frustrating to users. A website may annoy a user into leaving a website instead of trying to see whether a different browser would work better. Users expect that all web applications work correctly on any browser.

Figure 1.4.1: Browser usage trends.



Source: StatCounter GlobalStats

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Good practice is to ensure that web pages adhere closely to current technology standards, and that web pages work acceptably on all established browsers.



1) Because Chrome is by far the leading browser worldwide, testing a web page only really needs to be done using Chrome.

- True
- False

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2) Web developers typically create web pages using new features available exclusively on a particular browser.

- True
- False

3) Web developers can sometimes ignore really old web browsers.

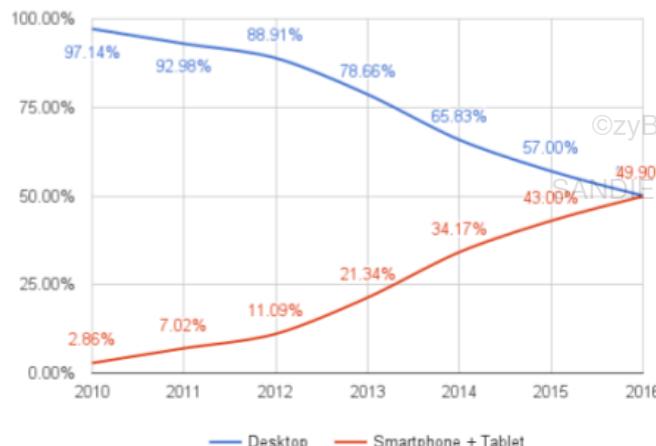
- True
- False



Mobile devices are replacing desktop computers on the web

Mobile devices are handheld computers such as smartphones and tablets. Although by 2010 mobile devices were already heavily used to browse the web in some countries, so few mobile devices were used worldwide for browsing that developers often avoided ensuring that web pages were mobile-friendly. The situation has changed. So much web browsing is done using mobile devices that web developers should design applications that work well on mobile devices.

Figure 1.4.2: Global browser usage trends.



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Data source: StatCounter GlobalStats (July 2010 to July 2016)

Developers of mobile-friendly web pages need to consider the following concerns:

- Screen size: Screen size is much smaller than desktops.
- Load speed: Mobile devices may have limited or slower Internet connectivity.
- Device speed: Limited memory and CPU speed of mobile devices means mobile browsers are not as powerful as desktop browsers.
- Data cost: Many users have data plans that limit how much content can be downloaded. Large web pages and web pages that keep requesting more data reach a mobile data plan's limit faster.
- Battery life: A web page that constantly runs JavaScript and frequently loads data will drain the battery faster.
- Interface: User interaction is with touch, not a mouse.

**PARTICIPATION
ACTIVITY**

1.4.2: Important mobile development topics.

Affordances

Mobile first

Screen size

Responsive web design

A web development approach that advocates first creating a reduced-feature version of a website for mobile users. Then, the developer creates a full-featured website for visitors using desktop computers.

Physical dimension in pixels of a device's screen.

Visual clues that guide the user in figuring out how to use an app.

A web design approach that creates web pages that automatically move and resize parts depending on the display size and orientation.

Reset

IoT: The Internet of Things

The **Internet of Things** (abbreviated as IoT) is the global collection of communicating devices that sense and control technology on behalf of humans. IoT devices range from a simple temperature sensor to a satellite-based laser scanner used to discover archaeological sites hidden by vegetation.

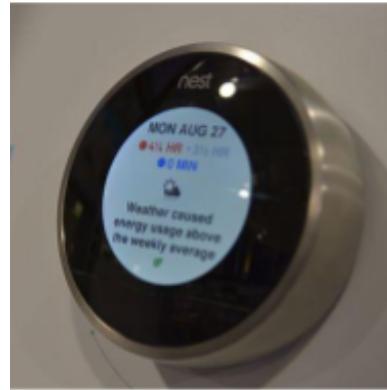
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Example 1.4.1: Example Internet of Things devices.



Nest learning thermostat



LG Internet refrigerator

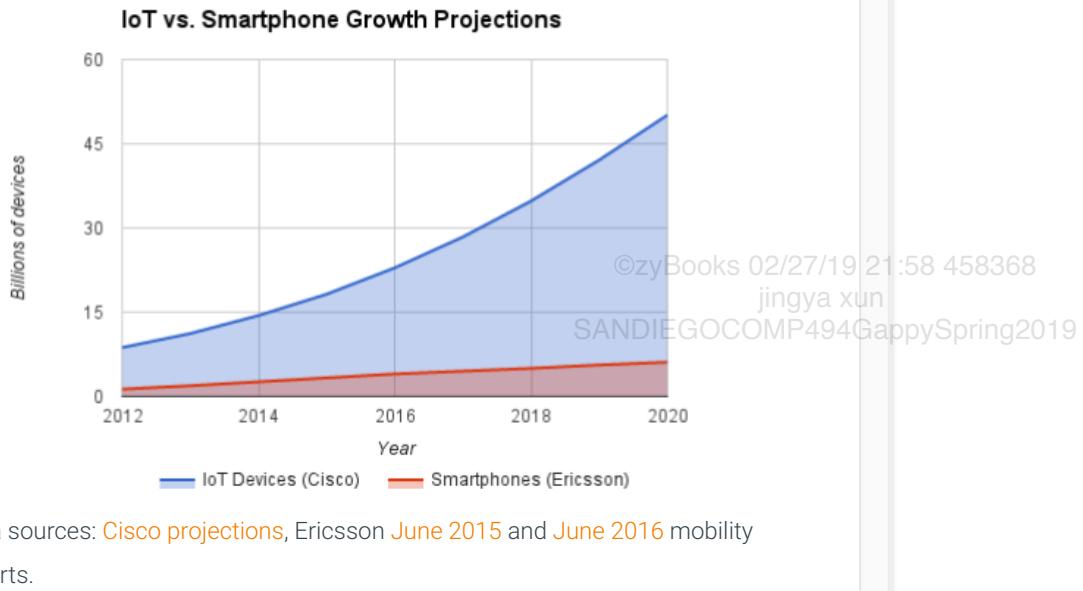
Source: Nest learning thermostat ([Raysonho @ Open Grid Scheduler / Grid Engine / Public domain via Wikimedia Commons](#)), Internet refridgerator ([LG전자 / CC-BY-2.0](#) via Wikimedia Commons)

Figure 1.4.3: Growth of IoT devices vs. smartphones.

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IoT devices display one or more of the following characteristics:

- Gather information about the physical world using sensors. Ex: temperature, voltage, images.
- Share the sensor data with control systems. Ex: A sensor may report a room's temperature to building control system, or air ozone and water pollution sensors reporting air quality data to urban environment monitoring systems.
- Interact with hardware to execute commands sent by control systems. Ex: Speed up fan moving hot air to part of a building where the sensed temperature is below the target temperature.

People do not typically interact directly with IoT devices. Instead, people access information and control devices using custom apps or web pages. Web developers typically build the web pages that present a system overview and allow users to select and display specific information from the aggregated sensor data. Web pages for IoT may allow a user to change system parameters or activate/deactivate parts of the system.

PARTICIPATION ACTIVITY

1.4.3: Internet of Things.



Could the following statements be true about an IoT-based system used to monitor a swimming pool for a pool service company?

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- 1) A technician installs devices that measure and report water chemical concentrations, water level, pump status, and water flow through the filter system.

True



False

- 2) The pool control system periodically transmits summary data over the Internet to a pool service company's web server.

 True False

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- 3) The pool company would have to send a technician to the pool to change the control system settings.

 True False

- 4) The pool company will not know that the water level is too low unless the customer calls or someone happens to check the system status web page.

 True False

- 5) If the customer notices the low water level and calls, the company receptionist's browser can have the customer's pool status web page loaded by the time the receptionist answers the phone.

 True False

- 6) After the customer reports the water level, the receptionist could inform the caller that a service technician was already dispatched and was six minutes from arriving at the house.

 True False

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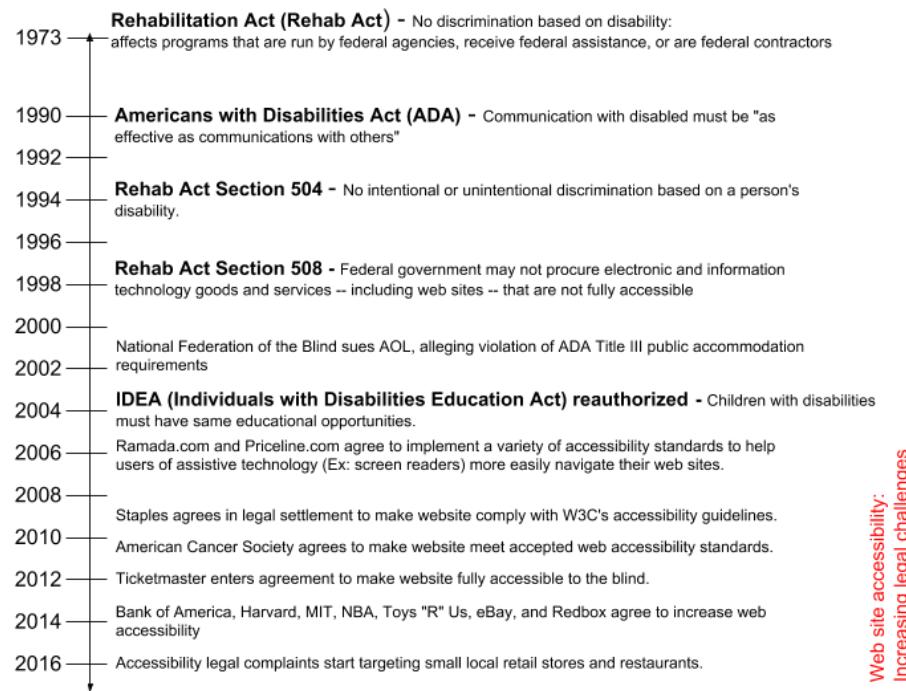


Web accessibility

Web accessibility is the ability of users with disabilities to access and use a web page with reasonable effort. Designing accessible web pages ensures equal access and opportunity for everyone. Developing accessible web pages requires knowledge of disabilities, assistive technologies and software used by users with disabilities, and following design practices to ensure content is compatible with those assistive tools. Some conditions affecting web accessibility include:

- Visual problems like blindness, low vision, or color blindness
- Hand control issues ranging from tremors to total inability to use hands
- Seizures caused by flashing on screen
- Cognitive challenges like dyslexia and other difficulties in processing web pages

Figure 1.4.4: Web accessibility timeline.



PARTICIPATION ACTIVITY

1.4.4: Accessibility fact check.

- 1) Really small businesses are exempt from web accessibility requirements.
 - True
 - False
- 2) Color blindness is so rare that web developers do not have to consider the issue when selecting colors for a web page.

True False

- 3) A random website is more likely to have a visitor with low vision than a visitor who is totally blind.

 True False

- 4) Unlike the blind, people who are deaf do not need special accommodation for websites.

 True False

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Cognitive computing and big data intelligence

Cognitive computing is the use of artificial intelligence techniques and access to vast amounts of data to simulate human problem solving in complex situations with ambiguity, changing data, and even conflicting information. IBM Watson is the symbol of this trend to create intelligent software systems that process massive numbers of web pages in order to extract information and address challenging problems in areas such as medical treatment, increasing retail sales, and improving the quality of call center help.

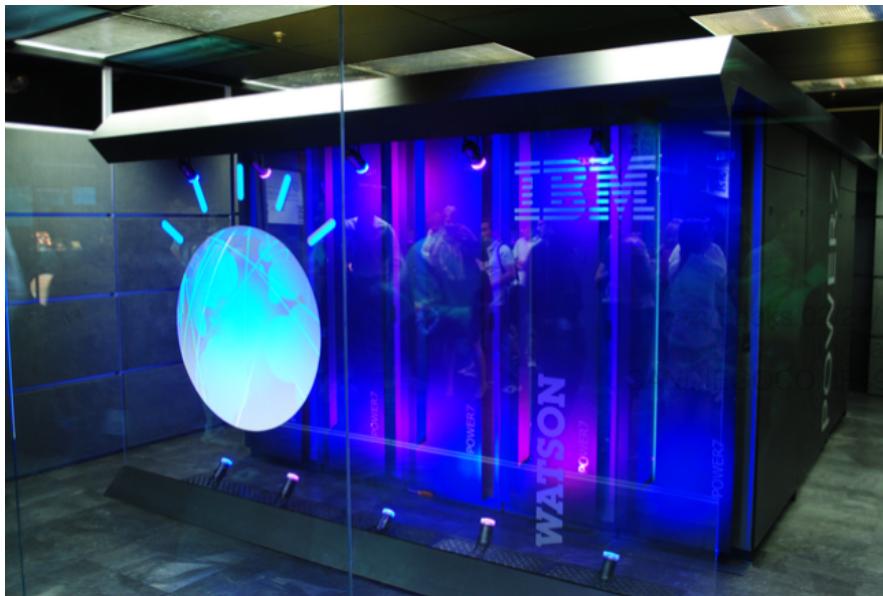
These intelligent systems need to know as much as possible about everything on web pages. In particular, systems such as Watson need to know the meaning of text. Text containing digits is more useful when the digits are stored as numbers in an HTML table with a title like "Pacemaker failure rates". Effective use of web page HTML metadata and structure markup makes the web page information more valuable to intelligent systems like Watson.

Figure 1.4.5: IBM Watson cognitive computing system.

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Source: IBM Watson([Clockready](#) / CC-BY-SA-3.0 via Wikimedia Commons)

Separation of concerns

Separation of concerns is the design principle of breaking up web content using distinct languages and documents that overlap as little as possible. In modern web design, document structure and text, visual layout, and page interaction are separately specified using three key languages.

- HTML is the language that describes the page content.
- CSS is the language that describes page layout.
- JavaScript is the language that provides interactive functionality.

When web pages are built so as to cleanly separate document structure, visual layout, and interaction, the following results are obtained:

- Web pages are more likely to work as intended across a wide range of browsers.
- Web pages work better on smartphones and other mobile devices.
- Internet of Things systems are easier to build because relevant data is easier to identify.
- Web accessibility is improved.
- Intelligent systems can extract more meaning from the content of web pages.

Standards conformance

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Web developers are expected to deliver content that will work well with all devices and browsers. Ideally, a web developer builds websites that will work on any browser, but can take advantage of recently added features available in newer browsers. Ex: A website that adds additional functionality for touch interfaces on mobile devices, but remains functional on desktops without a touch interface. As the variety of devices continues to proliferate, developing websites that comply to web standards ensures the website will operate correctly on as many devices as possible.

**PARTICIPATION
ACTIVITY**

1.4.5: Review trends in web technology.



1) Which browser lost the most market share between 2010 and 2015?

- Safari
- Chrome
- IE (Internet Explorer)

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2) Is Internet browsing more likely to be done using desktop computers or mobile devices in 2020?

- Desktop
- Mobile



3) How many cars, machines, meters, and other IoT devices did Cisco, a major network equipment manufacturer, predict would be connected to the Internet in 2020?

- 15 billion
- 30 billion
- 49 billion

4) Are human doctors or IBM's Watson more likely to keep up with new medical information in 2020?

- Human doctors
- IBM's Watson



Exploring further:

- [Internet of Things article in McKinsey Quarterly](#)
- [Wikipedia Internet of Things](#)
- [Wikipedia web accessibility](#)
- [W3C Web Accessibility initiative document](#)
- [Overview of United States laws relevant to web accessibility](#)

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1.5 Introduction to HTML

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HTML, CSS, and JavaScript are used together to create a web page. HTML defines the structure and content of a web page. CSS specifies the layout and visible appearance. JavaScript describes the dynamic behaviors and actions of a web page. As an analogy, humans have similar components: structure (bones, organs, central nervous system), identifying attributes (eye color, hair style, height), and behaviors (brushing teeth, slam dunking a basketball).

HTML (hypertext markup language) is a textual language for creating web pages. HTML files are usually saved with a .html or .htm file extension. Ex: index.html. An HTML file starts with an indication of the document type, then a head part with the page title and other page information, and finally a body part with the actual page content. The HTML file may also contain CSS and JavaScript code for smaller designs.

Figure 1.5.1: An HTML file and the rendered web page.

```
<!DOCTYPE html>
<html>
  <meta charset="UTF-8">
  <title>For sale: 2012 Ducati Streetfighter</title>
  <body>
    
    <h1>2012 Ducati Streetfighter 848 - $9000</h1>
    <p>2012 Ducati Streetfighter 848, Low Miles, Lots of Upgrades. Full service history.
      Call or text 555-4400.</p>
    <p>year: <strong>2012</strong></p>
    <p>make and model: <strong>Ducati Streetfighter 848</strong></p>
    <p>condition: <strong>excellent</strong></p>
    <p>engine: <strong>848</strong></p>
    <p>odometer: <strong>9500</strong></p>
    <p>paint color: <strong>yellow</strong></p>
  </body>
</html>
```

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2012 Ducati Streetfighter 848 - \$9000

2012 Ducati Streetfighter 848, Low Miles, Lots of Upgrades. Full service history. Call or text 555-4400.

year: 2012

make and model: Ducati Streetfighter 848

condition: excellent

engine: 848

odometer: 9500

paint color: yellow

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The body of an HTML document is constructed with several tags. Each tag has a descriptive name that the web browser uses to display content associated with the tag. Ex: <p> specifies a paragraph. Most HTML tags have an opening and closing tag. Ex:

<**strong**>always</**strong**> has an opening tag <**strong**> and closing tag </**strong**>. Some tags, such as <**img**>, do not require a closing tag.

Table 1.5.1: Common HTML tags.

Tags	Purpose	Example HTML
h1, h2,	Headers. h1 is	< h2 >Puppies are cute</ h2 >

h3	largest.	
p	Paragraph	<p>Humans seem designed to see puppies as cute.</p>
em, strong	Emphasis, strong emphasis	<p>"When in doubt, tell the truth" - Mark Twain.</p>
img	Image	 Note: src is the image's URL source.
a	Link	Click Here

**PARTICIPATION
ACTIVITY**

1.5.1: Practice with HTML tags.



Modify the HTML to include h2 and h3 headers, bold text, another paragraph, etc.

```

1  <!DOCTYPE html>
2  <html>
3    <meta charset="UTF-8">
4    <title>What I want to know...</title>
5    <body>
6      
7      <h1>Is Pluto a Planet?</h1>
8
9      <p>When I was young, <em>Pluto</em> was a planet. Then later, Pluto wasn't.
10         Now, Pluto may be a planet again. Well, <strong><em>is it or isn't it??</em></strong>
11
12    </body>
13  </html>
14

```

Render web page

Reset code

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Your web page

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Is Pluto a Planet?

When I was young, *Pluto* was a planet. Then later, Pluto wasn't. Now, Pluto may be a planet again. Well, *is it or isn't it??*

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1.5.2: Match HTML basic formatting.

ABC ABC <p>ABC</p> <h3>ABC</h3>

ABC

ABC

ABC

ABC

ABC

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ABC

Reset

A **link** on a web page is a clickable item that causes the web browser to jump to another web page when clicked. Ex: [Click here](#) is a link to an interesting website. A button or image can also

have a link.

**PARTICIPATION
ACTIVITY**

1.5.3: Creating a link in HTML.



Change the URL of the web page to your favorite web page. Add a second link. (Note: After clicking a link in the Preview window, you can use your keyboard's backspace/delete button to navigate back).

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```
1 <!DOCTYPE html>
2 <html>
3   <title>My Favorite Web Pages</title>
4   <body>
5     <p><a href="https://www.wikipedia.org/">Click Here</a> to visit my favorite web
6     <p>Click HERE to visit my second favorite web page.</p>
7   </body>
8 </html>
9
```

[Render web page](#)[Reset code](#)**Your web page**

[Click Here](https://www.wikipedia.org/) to visit my favorite web page.

Click HERE to visit my second favorite web page.

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1.5.4: HTML links.



Are the following valid HTML links?

1) `<a "https://cnn.com">CNN` □

- Valid
- Not valid

2) `News` □

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- Valid
- Not valid

3) `News` □

- Valid
- Not valid

How was this section?



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1.6 Introduction to CSS

A web page without any styling will use the browser's default styling with white background, black text, and standard-sized text. **Cascading Style Sheets (CSS)** is a textual language for describing how a web page is styled for visual presentation. CSS controls the look and layout of web page content.

Figure 1.6.1: HTML code without and with CSS style rules.

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```
<!DOCTYPE html>
<html>
  <meta charset="UTF-8">
  <title>For sale: 2012 Ducati
Streetfighter</title>
<body>
  <h1>Ducati Streetfighter - $9000</h1>
  <p>year: <strong>2012</strong></p>
  <p>make and model:<br/>
    <strong>Ducati Streetfighter
848</strong></p>
  <p>condition: <strong>excellent</strong></p>
  <p>odometer: <strong>9500</strong></p>
</body>
</html>
```

```
<!DOCTYPE html>
<html>
  <meta charset="UTF-8">
  <style>
    h1 {
      color: green;
      background-color: lightgray;
    }
    p {
      font-family: arial;
      margin-left: 10px;
    }
  </style>
  <title>For sale: 2012 Ducati
Streetfighter</title>
<body>
  <h1>Ducati Streetfighter - $9000</h1>
  <p>year: <strong>2012</strong></p>
  <p>make and model:<br/>
    <strong>Ducati Streetfighter
848</strong></p>
  <p>condition: <strong>excellent</strong></p>
  <p>odometer: <strong>9500</strong></p>
</body>
</html>
```

Ducati Streetfighter - \$9000

year: 2012

make and model: Ducati Streetfighter 848

condition: excellent

odometer: 9500

Ducati Streetfighter - \$9000

year: 2012

make and model: Ducati Streetfighter 848

condition: excellent

odometer: 9500

A **CSS rule** selects specific HTML elements and specifies styling properties for the element. Styling can occur within style tags in the HTML file's header part. Each style rule indicates the element to be styled like h1 (header1) or p (paragraph), followed by a list in braces {} of property:value items like color:blue.

Table 1.6.1: Common CSS properties.

Properties	Purpose	Example CSS
------------	---------	-------------

background-color	Element's background color	<pre>h1 { background-color: lightgray; }</pre>
font-family	Font used for the element's text.	<pre>p { font-family: arial; }</pre>
font-size	Font size used for the element's text.	©zyBooks 02/27/19 21:58 458368 jingya xun EGOCOMP494GappySpring2019
padding	Spacing between element's content and border.	<pre>strong { padding: 5px; }</pre>
margin	Spacing around element (outside element's border).	<pre>p { margin-left: 10px; }</pre> <p>Note: margin-top, margin-bottom, margin-left, and margin-right specify margin for individual sides.</p>

PARTICIPATION ACTIVITY**1.6.1: Styling a web page with CSS.**

Try changing the h1's font size to 16pt, the p's left margin to 30px, and the p's font family to Helvetica.

```

1 <!DOCTYPE html>
2 <html>
3 <meta charset="UTF-8">
4 <style>
5 h1 {
6     color: green;
7     background-color: lightgray;
8 }
9 p {
10    font-family: arial;
11    margin-left: 10px;
12 }
13 strong {
14     background-color: lightgreen;
15     padding: 5px;
16 }
17 </style>
18 <title>For sale: 2012 Ducati Streetfighter</title>
19 <body>
```

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[Render web page](#)[Reset code](#)**Your web page**

**2012 Ducati
Streetfighter 848 -**

Expected web page

**2012 Ducati Streetfighter 848 -
\$9000**

[2012 Ducati Streetfighter 848 Low](#)

A **CSS color** can be a pre-defined name as in color:blue, or an rgb value as in color:rgb(50, 100, 255). **rgb** is short for red, green, blue; all colors can be formed by combining those three colors. Values range from 0 (none) to 255 (bright).

Table 1.6.2: Some CSS colors using rgb.

RGB	Color	Description
rgb(255, 0, 0)		Bright red
rgb(0, 255, 0)		Bright green
rgb(0, 0, 255)		Bright blue
rgb(144,238,144)		A particular mix of red and blue, light green
rgb(150, 0, 150)		A particular mix of red and blue, yielding purple
rgb(100, 100, 100)		Equal red, green, blue yields gray
rgb(255, 255, 255)		Full red, green, blue yields white
rgb(0, 0, 0)		No red, green, or blue yields black

PARTICIPATION

**ACTIVITY****1.6.2: CSS colors.****Purple****Orange****Dark red****White**

rgb(200, 0, 0)

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rgb(250, 0, 250)

rgb(250, 150, 0)

rgb(255, 255, 255)

Reset**PARTICIPATION**
ACTIVITY**1.6.3: CSS colors.**

Try changing h1's color to rgb(40,40,40), and changing strong's color to rgb(100,100,100).

```

1 <!DOCTYPE html>
2 <html>
3 <meta charset="UTF-8">
4 <style>
5   h1 {
6     font-size: 16pt;
7     color: black;
8     background-color: lightgreen;
9   }
10  p {
11    font-size: 12pt;
12    margin-left: 10px;
13  }
14  img {
15    margin-left: 10px;
16  }
17  em {
18    color: darkblue;
19 }
```

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Render web page**Reset code**

Your web page

Kyoto Kaiseki Restaurant Review

Rating (1-5): 5

Favorite dish: Mixed sashimi



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How was this section?



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1.7 Introduction to JavaScript

JavaScript is a programming language that runs in a browser, enabling web pages supporting actions like responding to a button click. JavaScript can be included in the HTML file's header part.

PARTICIPATION
ACTIVITY

1.7.1: JavaScript to change colors.



Click the buttons. Try adding a third button for "blue".

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```

1 <!DOCTYPE html>
2 <html>
3   <meta charset="UTF-8">
4   <script>
5     function ChangeTextColor(newColor) {
6       var x = document.getElementById("Colorable");
7       x.style.color = newColor;
8     }
9   </script>
10  <style>
11    h1 {
12      color: green;
13      background-color: lightgray;
14      font-size: 16pt;
15    }
16    p {
17      font-family: arial;
18      margin-left: 10px;
19  }

```

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[Render web page](#)[Reset code](#)**Your web page****Ducati Streetfighter - \$9000****year: 2012****make and model: Ducati Streetfighter 848****condition: excellent****odometer: 9500**Change heading color to: [White](#) [Green](#)

In the HTML above:

- The script tags indicates JavaScript code, consisting of a function named ChangeTextColor. A JavaScript **function** is a named group of statements that can be run by referring to that name.
- Two button elements are created, each with an attribute named onclick. The onclick attribute is set to the function ChangeTextColor. Thus, when a button is clicked, the function ChangeTextColor is run, using the value passed to the function (either 'white' or 'green').
- The h1 heading has an id of Colorable. The ChangeTextColor function's statements change the h1's color. The function uses document.getElementById("idName"), which searches the

HTML document for and returns an element whose id="idName". newColor and x are both examples of variables. A **variable** stores a value or a link to an element of a web page.

Using the link stored in a variable allows JavaScript to directly modify the properties of an element defined elsewhere in the HTML document. Ex: x stores the element with id="Colorable".

PARTICIPATION
ACTIVITY

1.7.2: The colorable JavaScript example.

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`x = document.getElementById("Colorable")`

`<button type="button" onclick="ChangeTextColor('blue')>Blue</button>`

`onclick="ChangeTextColor('white')"` `<h1 id="ColorableText">...`

Gives this h1 heading a label, so that a function can find the heading to change the heading's color.

Indicates that the JavaScript function ChangeTextColor should be executed, with the value 'white'.

Finds the element with id 'Colorable', and sets x to that element. x can then be used to change that element's attributes, like color.

The HTML that should be added to create a third button.

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The JavaScript example below shows a function with an "if-else" statement for setting the color of the rating stars based on the value passed to the function. The HTML below defines five span elements, which are inline containers used to manage HTML content. Each span element has a unique id and contains a single * for the rating star. The JavaScript code can change each rating stars' color by changing the span's color.

PARTICIPATION
ACTIVITY

1.7.3: Updating user ratings.



Click the buttons. Try adding three more buttons for ratings 3, 2, and 1. Try replacing the * with a star (★). To specify a star, use ★, which is the HTML entity for displaying a star.

```

1  <!DOCTYPE html>
2  <html>
3    <meta charset="UTF-8">
4    <script>
5      function UpdateRating(newRating) {
6        var star1 = document.getElementById("rating1");
7        var star2 = document.getElementById("rating2");
8        var star3 = document.getElementById("rating3");
9        var star4 = document.getElementById("rating4");
10       var star5 = document.getElementById("rating5");
11
12       if (newRating == 5) {
13         star5.style.color = "blue";
14         star4.style.color = "blue";
15         star3.style.color = "blue";
16         star2.style.color = "blue";
17         star1.style.color = "blue";
18     }
19     else if (newRating == 4) {

```

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[Render web page](#)[Reset code](#)**Your web page**

Kyoto Kaiseki Restaurant Review

Rating: ★★★★**Update rating:** [Rate 4](#) [Rate 5](#)**Favorite dish:** Mixed sashimi

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ACTIVITY

1.7.4: JavaScript for updating user ratings.

Refer to the JavaScript example above

- 1) What is the id of the span containing the



third rating star?

Check**Show answer**

- 2) If the user clicks the "Rate 4" button, to what color is the fourth rating star set?

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Check**Show answer**

More advanced interactive web pages, such as a user-entry form or a browser-based video game, may involve hundreds or thousands of JavaScript statements. JavaScript programs are thus commonly placed in a separate file, typically ending in .js, and linked to in an HTML file's head part.

Here are two versions of the popular game Tetris, written in JavaScript: [Tetris1](#), [Tetris2](#).

**PARTICIPATION
ACTIVITY**

1.7.5: JavaScript example: Analog clock.



JavaScript can also be used to draw graphics. Play around with this clock by changing the time. Note: No changes are needed.

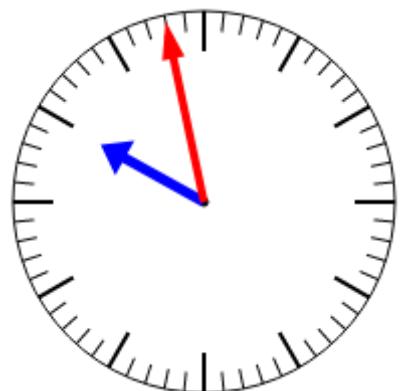
```
1 <!DOCTYPE html>
2 <html>
3   <meta charset="UTF-8">
4   <style>
5     .hour-input {
6       color: blue;
7       margin-right: 5px;
8       width: 30px
9     }
10    .minute-input {
11      color: red;
12      margin-left: 5px;
13      width: 30px
14    }
15  </style>
16  <body>
17    <canvas id='clockCanvas' width='200' height='200'></canvas>
18    <div class='button-container'>
19
```

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Render web page**Reset code**

Your web page

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Draw current time

: Draw time

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