

GLOBAL
EDITION



Web Development and Design Foundations with HTML5

EIGHTH EDITION

Terry Ann Felke-Morris



8th Edition
Global Edition

Web Development and Design Foundations with HTML5

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Professor Emerita
Harper College



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Pearson Education Limited
Edinburgh Gate
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Authorized adaptation from the United States edition, entitled Web Development and Design Foundations with HTML5, 8th Edition, ISBN 978-0-13-432275-9, by Terry Ann Felke-Morris published by Pearson Education © 2017.

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British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

10 9 8 7 6 5 4 3 2 1

ISBN 10: 1-292-16407-7
ISBN 13: 978-1-292-16407-6 (Print)
ISBN 13: 978-1-292-16408-3 (PDF)

Typeset by SPi Global
Printed and bound in Malaysia.

Preface

Web Development and Design Foundations with HTML5 is intended for use in a beginning web development course. This textbook introduces HTML and CSS topics such as text configuration, color configuration, and page layout, with an enhanced focus on the topics of design, accessibility, and Web standards. The text covers the basics that web developers need to build a foundation of skills:

- Internet concepts
- Creating web pages with HTML5
- Configuring text, color, and page layout with Cascading Style Sheets (CSS)
- Web design best practices
- Accessibility standards
- The web development process
- Using media and interactivity on web pages
- New CSS3 properties
- Website promotion and search engine optimization
- E-commerce and the Web
- JavaScript

A special feature of this text is the *Web Developer's Handbook*, which is a collection of appendixes that provide resources such as an HTML5 Reference, XHTML Reference, Comparison of XHTML and HTML5, Special Entity Character List, CSS Property Reference, WCAG 2.0 Quick Reference, FTP Tutorial, and web-safe color palette.

New to This Edition

Building on this textbook's successful seventh edition, new features for the eighth edition include the following:

- Updated coverage of HTML5 elements and attributes
- Expanded coverage of designing for mobile devices
- Expanded coverage of responsive web design techniques and CSS media queries
- Expanded coverage of responsive image techniques including the new HTML5 picture element
- Introduction of CSS coding techniques for dynamic menus
- Updated reference sections for HTML5 and CSS
- Additional Hands-On Practice exercises

- A new case study
- Updated code samples, case studies, and web resources

Student files are available for download from the companion website for this textbook at www.pearsonglobaleditions.com/felke-morris. These files include solutions to the Hands-On Practice exercises, the Website Case Study starter files, and access to the book's companion VideoNotes. See the access card in the front of this textbook for further instructions.

Design for Today and Tomorrow

This textbook has a modern approach that prepares students to design web pages that work today, in addition to being ready to take advantage of the new HTML5 and CSS3 coding techniques of the future.

Organization of the Text

This textbook is designed to be used in a flexible manner; it can easily be adapted to suit a variety of course and student needs. Chapter 1 provides introductory material, which may be skipped or covered, depending on the background of the students. Chapters 2 through 4 introduce HTML and CSS coding. Chapter 5 discusses web design best practices and can be covered anytime after Chapter 3 (or even along with Chapter 3). Chapters 6 through 9 continue with HTML and CSS.

Any of the following chapters may be skipped or assigned as independent study, depending on time constraints and student needs: Chapter 7 (More on Links, Layout, and Mobile), Chapter 10 (Web Development), Chapter 11 (Web Multimedia and Interactivity), Chapter 12 (E-Commerce Overview), Chapter 13 (Web Promotion), and Chapter 14 (A Brief Look at JavaScript and jQuery). A chapter dependency chart is shown in Figure P.1.

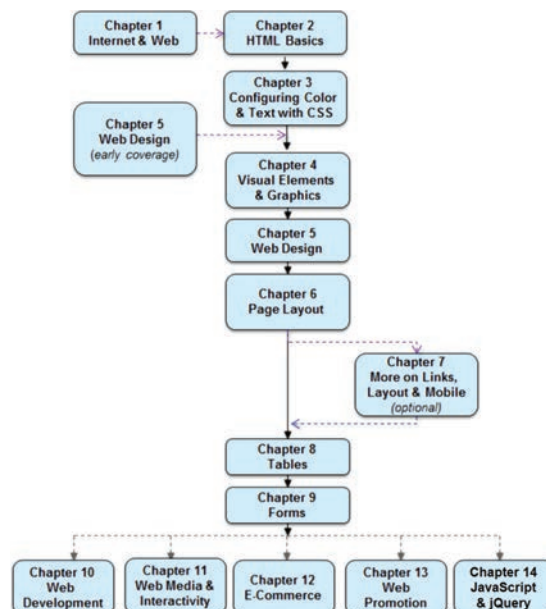


Figure P.1 This textbook is flexible and can be adapted to individual needs

Brief Overview of Each Chapter

Chapter 1: Introduction to the Internet and World Wide Web This brief introduction covers the terms and concepts related to the Internet and the Web with which Web developers need to be familiar. For many students, some of this will be a review. Chapter 1 provides the base of knowledge on which the rest of the textbook is built.

Chapter 2: HTML Basics As HTML5 is introduced, examples and exercises encourage students to create sample pages and gain useful experience. Solution pages for the Hands-On Practice are available in the student files.

Chapter 3: Configuring Color and Text with CSS The technique of using Cascading Style Sheets to configure the color and text on web pages is introduced. Students are encouraged to create sample pages as they read through the text. Solutions for the Hands-On Practice are available in the student files.

Chapter 4: Visual Elements and Graphics This chapter discusses the use of graphics and visual effects on web pages, including image optimization, CSS borders, CSS image backgrounds, new CSS3 visual effects, and new HTML5 elements. Students are encouraged to create web pages as they read through the text. Sample solutions for the Hands-On Practice are available in the student files.

Chapter 5: Web Design This chapter focuses on recommended web design practices and accessibility. Some of this is reinforcement because tips about recommended website design practices are incorporated into the other chapters.

Chapter 6: Page Layout This chapter continues the study of CSS begun earlier and introduces techniques for positioning and floating web page elements, including a two-column CSS page layout. New HTML5 semantic elements and techniques to provide HTML5 compatibility for older browsers are also introduced. Sample solutions for the Hands-On Practice are available in the student files.

Chapter 7: More on Links, Layout, and Mobile This chapter revisits earlier topics and introduces more advanced techniques related to hyperlinks, using CSS sprites, a three-column page layout, configuring CSS for print, designing pages for the mobile web, responsive web design with CSS media queries, responsive images, and the new CSS3 Flexible Box Layout Module. Students are encouraged to create pages as they read through the text. Sample solutions for the Hands-On Practice are available in the student files.

Chapter 8: Tables This chapter focuses on the HTML elements used to create tables. Methods for configuring a table with CSS are introduced. Students are encouraged to create pages as they read through the text. Sample solutions for the Hands-On Practice are available in the student files.

Chapter 9: Forms This chapter focuses on the HTML elements used to create forms. Methods for configuring the form with CSS are introduced. New HTML5 form control elements and attribute values are introduced. Students are encouraged to create sample pages as they read through the text. Sample solutions for the Hands-On Practice are available in the student files.

Chapter 10: Web Development This chapter focuses on the process of website development, including the job roles needed for a large-scale project, the web development process, and web hosting. A web host checklist is included in this chapter.

Chapter 11: Web Multimedia and Interactivity This chapter offers an overview of topics related to adding media and interactivity to web pages. These topics include new HTML5 video and audio, Flash[®], Java[™] applets, new CSS3 transform and transition properties, interactive CSS menu, interactive image gallery, JavaScript, jQuery, Ajax, and new HTML5 APIs. Students are encouraged to create pages as the topics are discussed. Sample solutions for the Hands-On Practice are available in the student files.

Chapter 12: E-Commerce Overview This chapter introduces e-commerce, security, and order processing on the Web.

Chapter 13: Web Promotion This chapter discusses site promotion from the web developer's point of view and introduces search engine optimization.

Chapter 14: A Brief Look at JavaScript and jQuery This chapter provides an introduction to client-side scripting using JavaScript and jQuery. Sample solutions for the Hands-On Practice are available in the student files.

Web Developer's Handbook Appendixes: This handbook contains appendixes that include resources and tutorials that are useful for students, such as an HTML5 Quick Reference, an XHTML Quick Reference, Special Entity Characters, a Comparison of XHTML and HTML5, a CSS Property Reference, a WCAG 2.0 Quick Reference, an FTP Tutorial, and a web-safe color palette.

Features of the Text

Well-Rounded Selection of Topics This text includes both “hard” skills such as HTML5, CSS, and JavaScript (Chapters 2, 3, 4, 6, 7, 8, 9, and 14) and “soft” skills such as web design (Chapter 5), website promotion (Chapter 13), and e-commerce (Chapter 12). This well-rounded foundation will help students as they pursue careers as web professionals. Students and instructors will find classes more interesting because they can discuss, integrate, and apply both hard and soft skills as students create web pages and websites.

Hands-On Practice Web development is a skill and skills are best learned by hands-on practice. This text emphasizes hands-on practice through exercises within the chapters, end-of-chapter exercises, and the development of websites through ongoing real-world case studies. The variety of exercises provides instructors with a choice of assignments for a particular course or semester.

Website Case Studies There are four case studies that continue throughout most of the text (starting with Chapter 2). An additional case study starts in Chapter 5. The case studies serve to reinforce the skills discussed in each chapter. Instructors can cycle assignments from semester to semester or allow students to choose the case study that most interests them. Sample solutions to the case studies are available for download from the Instructor Resource Center at www.pearsonglobaleditions.com/felke-morris.

Web Research Each chapter offers web research activities that encourage students to further study the topics introduced in the chapter.

Focus on Web Design Most chapters offer additional activities that explore the web design topics related to the chapter. These activities can be used to reinforce, extend, and enhance the course topics.

FAQs In the author's web development courses, she is frequently asked similar questions by students. They are included in this textbook and are marked with the identifying FAQ logo.

Checkpoints Each chapter contains two or three Checkpoints, which are groups of questions to be used by students to self-assess their understanding of the material. A special Checkpoint icon appears with each group of questions.

Focus on Accessibility Developing accessible websites is more important than ever and this textbook is infused with accessibility techniques throughout. The special icon shown here makes accessibility information easy to find.

Focus on Ethics Ethics issues related to web development are highlighted throughout the textbook and are marked with the special ethics icon shown here.

Reference Materials The appendixes in the *Web Developer's Handbook* offer reference materials, including an HTML5 Quick Reference, an XHTML Quick Reference, Special Entity Characters, Comparison of XHTML and HTML5, a CSS Property Reference, a WCAG 2.0 Quick Reference, an FTP Tutorial, and a Web-Safe Color Palette.

VideoNotes VideoNotes are Pearson's new visual tool designed for teaching students key programming concepts and techniques. These short step-by-step videos demonstrate how to solve problems from design through coding. VideoNotes allow for self-placed instruction with easy navigation including the ability to select, play, rewind, fast-forward, and stop within each VideoNote exercise.

Margin icons in your textbook let you know when a VideoNote video is available for a particular concept or homework problem.

Supplemental Materials

Student Resources The student files for the web page exercises, Website Case Study assignments, and access to the book's VideoNotes are available to all readers of this textbook at its companion website www.pearsonglobaleditions.com/felke-morris. A complimentary access code for the companion website is available with a new copy of this textbook.

Instructor Resources The following supplements are available to qualified instructors only. Visit the Pearson Instructor Resource Center (www.pearsonglobaleditions.com/felke-morris) for information on how to access them:

- Solutions to the end-of-chapter exercises
- Solutions for the case study assignments



**Focus on
Accessibility**



**Focus on
Ethics**



VideoNote

- Test questions
- PowerPoint® presentations
- Sample syllabi

Acknowledgments

Very special thanks go to all the folks at Pearson, especially Michael Hirsch, Matt Goldstein, Carole Snyder, Camille Trentacoste, and Scott Disanno.

Thank you to the following people who provided comments and suggestions that were useful for this eighth edition and previous editions:

Carolyn Andres—*Richland College*
 James Bell—*Central Virginia Community College*
 Ross Beveridge—*Colorado State University*
 Karmen Blake—*Spokane Community College*
 Jim Buchan—*College of the Ozarks*
 Dan Dao—*Richland College*
 Joyce M. Dick—*Northeast Iowa Community College*
 Elizabeth Drake—*Santa Fe Community College*
 Mark DuBois—*Illinois Central College*
 Genny Espinoza—*Richland College*
 Carolyn Z. Gillay—*Saddleback College*
 Sharon Gray—*Augustana College*
 Tom Gutnick—*Northern Virginia Community College*
 Jason Hebert—*Pearl River Community College*
 Sadie Hébert—*Mississippi Gulf Coast College*
 Lisa Hopkins—*Tulsa Community College*
 Barbara James—*Richland Community College*
 Nilofar Kadivi—*Richland Community College*
 Jean Kent—*Seattle Community College*
 Mary Keramidas—*Sante Fe College*
 Karen Kowal Wiggins—*Wisconsin Indianhead Technical College*
 Manasseh Lee—*Richland Community College*
 Nancy Lee—*College of Southern Nevada*
 Kyle Loewenhagen—*Chippewa Valley Technical College*
 Michael J. Losacco—*College of DuPage*
 Les Lusk—*Seminole Community College*
 Mary A. McKenzie—*Central New Mexico Community College*
 Bob McPherson—*Surry Community College*
 Cindy Mortensen—*Truckee Meadows Community College*
 John Nadzam—*Community College of Allegheny County*
 Teresa Nickeson—*University of Dubuque*
 Brita E. Penttila—*Wake Technical Community College*
 Anita Philipp—*Oklahoma City Community College*
 Jerry Ross—*Lane Community College*
 Noah Singer—*Tulsa Community College*
 Alan Strozer—*Canyons College*
 Lo-An Tabar-Gaul—*Mesa Community College*
 Jonathan S. Weissman—*Finger Lakes Community College*

Tebring Wrigley—*Community College of Allegheny County*
Michelle Youngblood-Petty—*Richland College*

A special thank you also goes to Jean Kent, North Seattle Community College, and Teresa Nickeson, University of Dubuque, for taking time to provide additional feedback and sharing student comments about the book.

Thanks are in order to colleagues at William Rainey Harper College for their support and encouragement, especially Ken Perkins, Enrique D'Amico, and Dave Braunschweig.

Most of all, I would like to thank my family for their patience and encouragement. My wonderful husband, Greg Morris, has been a constant source of love, understanding, support, and encouragement. Thank you, Greg! A big shout-out to my children, James and Karen, who grew up thinking that everyone's Mom had their own website. Thank you both for your understanding, patience, and timely suggestions! And, finally, a very special dedication to the memory of my father who is greatly missed.

Acknowledgments for the Global Edition

Pearson would like to thank and acknowledge the following people for their contributions to the Global Edition.

Contributors

Kaushik Goswami—*St. Xavier's College, Kolkata*
Atul Kahate—*Pune University*

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With more than 25 years of information technology experience in business and industry, Dr. Felke-Morris published her first website in 1996 and has been working with the Web ever since. A long-time promoter of Web standards, she was a member of the Web Standards Project Education Task Force. Dr. Felke-Morris was instrumental in developing the Web Development certificate and degree programs at William Rainey Harper College. For more information about Dr. Terry Ann Felke-Morris, visit <http://terrymorris.net>.

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Introduction to the Internet and World Wide Web

Chapter Objectives

In this chapter, you will learn how to . . .

- Describe the evolution of the Internet and the Web
- Explain the need for web standards
- Describe universal design
- Identify benefits of accessible web design
- Identify reliable resources of information on the Web
- Identify ethical use of the Web
- Describe the purpose of web browsers and web servers
- Identify networking protocols
- Define URIs and domain names
- Describe HTML, XHTML, and HTML5
- Describe popular trends in the use of the Web

The Internet and the Web are parts of our daily lives. How did they begin? What networking protocols and programming languages work behind the scenes to display a web page? This chapter provides an introduction to some of these topics and is a foundation for the information that web developers need to know. You'll be introduced to Hypertext Markup Language (HTML), the language used to create web pages.

1.1 The Internet and the Web

The Internet

The **Internet**, the interconnected network of computer networks that spans the globe, seems to be everywhere today. It has become part of our lives. You can't watch television or listen to the radio without being urged to visit a website. Even newspapers and magazines have their place on the Internet.

Birth of the Internet

The Internet began as a network to connect computers at research facilities and universities. Messages in this network would travel to their destination by multiple routes, or paths. This configuration allowed the network to function even if parts of it were broken or destroyed. In such an event, the message would be rerouted through a functioning portion of the network while traveling to its destination. This network was developed by the Advanced Research Projects Agency (ARPA)—and the ARPAnet was born. Four computers (located at UCLA, Stanford Research Institute, University of California Santa Barbara, and the University of Utah) were connected by the end of 1969.

Growth of the Internet

As time went on, other networks, such as the National Science Foundation's NSFnet, were created and connected with the ARPAnet. Use of this interconnected network, or Internet, was originally limited to government, research, and educational purposes. The number of individuals accessing the Internet continues to grow each year. According to Internet World Stats (<http://www.internetworldstats.com/emarketing.htm>), the percentage of the global population that used the Internet was 0.4% in 1995, 5.8% in 2000, 15.7% in 2005, 28.8% in 2010, and 45% in 2015. Visit <http://www.internetworldstats.com> to explore more statistics about the usage and growth of the Internet.

The lifting of the restriction on commercial use of the Internet in 1991 set the stage for future electronic commerce: Businesses were now welcome on the Internet. However, the Internet was still text based and not easy to use. The next set of developments solved this issue.

Birth of the Web

While working at CERN, a research facility in Switzerland, **Tim Berners-Lee** envisioned a means of communication for scientists by which they could easily “hyperlink” to another research paper or article and immediately view it. Berners-Lee created the World Wide Web to fulfill this need. In 1991, Berners-Lee posted the code for the Web in a newsgroup and made it freely available. This version of the World Wide Web used **Hypertext Transfer Protocol (HTTP)** to communicate between the client computer and the web server, used **Hypertext Markup Language (HTML)** to format the documents, and was text based.

The First Graphical Browser

In 1993, Mosaic, the first graphical web browser became available. Marc Andreessen and graduate students working at the National Center for Supercomputing Applications (NCSA) at the University of Illinois Urbana-Champaign developed Mosaic. Some individuals in this



group later created another well-known web browser—Netscape Navigator—which is an ancestor of today’s Mozilla Firefox browser.

Convergence of Technologies

By the early 1990s, personal computers with easy-to-use graphical operating systems (such as Microsoft’s Windows, IBM’s OS/2, and Apple’s Macintosh OS) were increasingly available and affordable. Online service providers such as CompuServe, AOL, and Prodigy offered low-cost connections to the Internet. Figure 1.1 depicts this convergence of available computer hardware, easy-to-use operating systems, low-cost Internet connectivity, the HTTP protocol and HTML language, and a graphical browser that made information on the Internet much easier to access. The **World Wide Web**—the graphical user interface to information stored on computers running web servers connected to the Internet—had arrived!

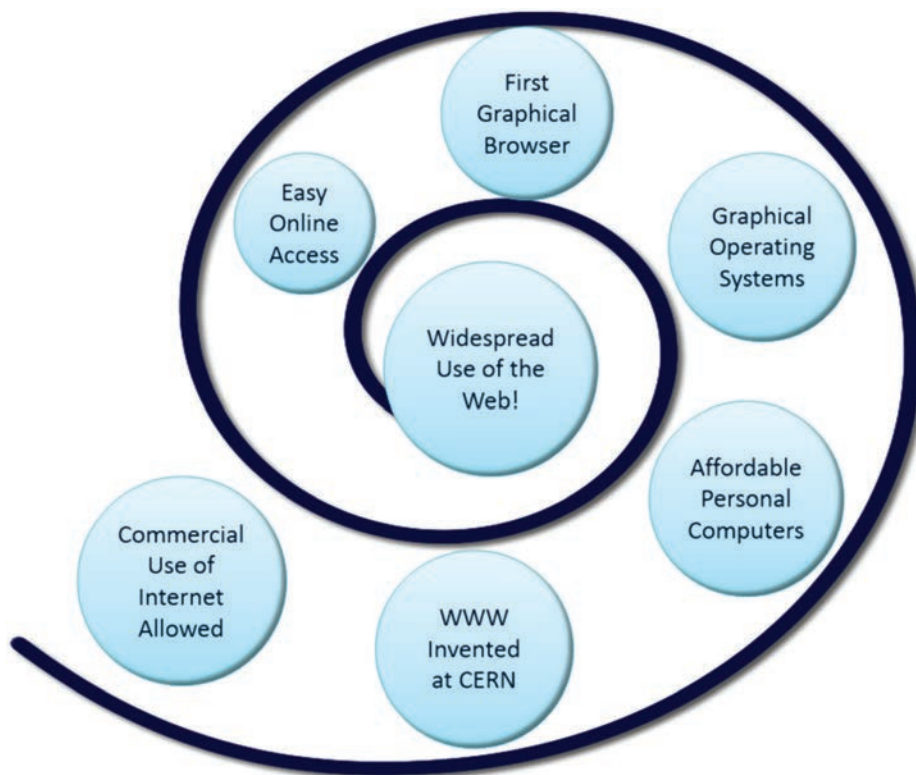


Figure 1.1 Convergence of Technologies. Used by permission of World Wide Web Consortium (W3C)

Who Runs the Internet?

You may be surprised that there is no single person “in charge” of the global interconnected network of computer networks known as the Internet. Instead, Internet infrastructure standards are overseen by groups such as the **Internet Engineering Task Force (IETF)** and the **Internet Architecture Board (IAB)**. The IETF is the principal body engaged in the development of new Internet protocol standard specifications. It is an open international community of network designers, operators, vendors, and researchers concerned with the evolution of Internet architecture and the smooth operation of the Internet. The actual technical work of the IETF is completed in its working groups. These working groups are organized into areas by topic, such as security and routing.

The IAB is a committee of the IETF and provides guidance and broad direction to the IETF. As a function of this purpose, the IAB is responsible for the publication of the **Request for Comments (RFC)** document series. An RFC is a formal document from the IETF that is drafted by a committee and subsequently reviewed by interested parties. RFCs are available for online review at <http://www.ietf.org/rfc.html>. Some RFCs are informational in nature, while others are meant to become Internet standards. In the latter case, the final version of the RFC becomes a new standard. Future changes to the standard must be made through subsequent RFCs.

The **Internet Corporation for Assigned Numbers and Names (ICANN)**, <http://www.icann.org>, was created in 1998 and is a nonprofit organization. Its main function is to coordinate the assignment of Internet domain names, IP address numbers, protocol parameters, and protocol port numbers. Prior to 1998, the **Internet Assigned Numbers Authority (IANA)** coordinated these functions. IANA still performs certain functions under the guidance of ICANN and maintains a website at <http://www.iana.org>.

Intranets and Extranets

Recall that the Internet is an interconnected network of computer networks that is globally available. When an organization needs the communication capabilities of the Internet, but doesn't want its information to be available to everyone, either an intranet or extranet is appropriate.

An **intranet** is a private network that is contained within an organization or business. Its purpose is to share organizational information and resources among coworkers. When an intranet connects to the outside Internet, usually a gateway or firewall protects the intranet from unauthorized access.

An **extranet** is a private network that securely shares part of an organization's information or operations with external partners such as suppliers, vendors, and customers. Extranets can be used to exchange data, share information exclusively with business partners, and collaborate with other organizations. Privacy and security are important issues in extranet use. Digital certificates, encryption of messages, and virtual private networks (VPNs) are some technologies used to provide privacy and security for an extranet. Digital certificates and encryption used in e-commerce are discussed in Chapter 12.

1.2 Web Standards and Accessibility

Just as with the Internet, no single person or group runs the World Wide Web. However, the **World Wide Web Consortium** (<http://www.w3.org>), referred to as the **W3C**, takes a proactive role in developing recommendations and prototype technologies related to the Web. Topics that the W3C addresses include web architecture, standards for web design, and accessibility. In an effort to standardize web technologies, the W3C produces specifications called recommendations.

W3C Recommendations

The W3C Recommendations are created in working groups with input from many major corporations involved in building web technologies. These recommendations are not rules; they are guidelines. Major software companies that build web browsers, such as Microsoft, do not always follow the W3C Recommendations. This makes life challenging for web developers because not all browsers will display a web page in exactly the same way. The good news

is that there is a convergence toward the W3C Recommendations in new versions of major browsers. You'll follow W3C Recommendations as you code web pages in this book. Following the W3C Recommendations is the first step toward creating a website that is accessible.

Web Standards and Accessibility

The **Web Accessibility Initiative (WAI)** (<http://www.w3.org/WAI>), is a major area of work by the W3C. Since the Web has become an integral part of daily life, there is a need for all individuals to be able to access it.

The Web can present barriers to individuals with visual, auditory, physical, and neurological disabilities. An **accessible** website provides accommodations that help individuals overcome these barriers. The WAI has developed recommendations for web content developers, web authoring tool developers, web browser developers, and developers of other user agents to facilitate use of the Web by those with special needs. See the WAI's **Web Content Accessibility Guidelines (WCAG)** at <http://www.w3.org/WAI/WCAG20/glance/WCAG2-at-a-Glance.pdf> for a quick overview.



Focus on
Accessibility

Accessibility and the Law

The **Americans with Disabilities Act (ADA)** of 1990 is a federal civil rights law that prohibits discrimination against people with disabilities. The ADA requires that business, federal, and state services are accessible to individuals with disabilities. A 1996 Department of Justice ruling (http://www.justice.gov/crt/foia/readingroom/frequent_requests/ada_coreletter/cltr204.txt) indicated that ADA accessibility requirements apply to Internet resources.

Section 508 of the Federal Rehabilitation Act was amended in 1998 to require that U.S. government agencies give individuals with disabilities access to information technology that is comparable to the access available to others. This law requires developers creating information technology (including web pages) for use by the federal government to provide for accessibility. The **Federal IT Accessibility Initiative** (<http://www.section508.gov>) provides accessibility requirement resources for information technology developers. As the Web and Internet technologies developed, it became necessary to review the original Section 508 requirements. New proposed Section 508 requirements were aligned to WCAG 2.0 guidelines and released for comment in 2015. This textbook focuses on WCAG 2.0 guidelines to provide for accessibility.

In recent years, state governments have also begun to encourage and promote web accessibility. The Illinois Information Technology Accessibility Act (IITAA) guidelines (see <http://www.dhs.state.il.us/IITAA/IITAAWebImplementationGuidelines.html>) are an example of this trend.



Focus on
Accessibility

Universal Design for the Web

The Center for Universal Design defines universal design as “the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.” Examples of universal design are all around us. The cutouts on curbs that make it possible for people in wheelchairs to access the street also benefit a person pushing a stroller or riding a Segway Personal Transporter (Figure 1.2). Doors that



Figure 1.2 A smooth ride is a benefit of universal design. Definition from *The Principles of Universal Design* by The Center for Universal Design. Published by NC State University, ©1997

open automatically for people with mobility challenges also benefit people carrying packages. A ramp is useful for a person in a wheelchair, a person dragging a rolling backpack or carry-on bag, and so on.

Awareness of universal design by web developers has been steadily increasing. Forward-thinking web developers design with accessibility in mind because it is the right thing to do. Providing access for visitors with visual, auditory, and other challenges should be an integral part of web design rather than an afterthought.

A person with visual difficulties may not be able to use graphical navigation buttons and may use a screen reader device to provide an audible description of the web page. By making a few simple changes, such as providing text descriptions for the images and perhaps providing a text navigation area at the bottom of the page, web developers can make the page accessible. Often, providing for accessibility increases the usability of the website for all visitors.

Accessible websites, with alternative text for images, headings used in an organized manner, and captions or transcriptions for multimedia features, are more easily used not only by visitors with disabilities, but also by visitors using a browser on a mobile device such as a phone or tablet. Finally, accessible websites may be more thoroughly indexed by search engines, which can be helpful in bringing new visitors to a site. As this text introduces web development and design techniques, corresponding web accessibility and usability issues are discussed.

Focus on
Accessibility



1.3 Information on the Web

These days anyone can publish just about anything on the Web. In this section we'll explore how you can tell if the information you've found is reliable and how you can use that information.

Reliability and Information on the Web

There are many websites—but which ones are reliable sources of information? When visiting websites to find information, it is important not to take everything at face value (Figure 1.3).

Questions to ask about web resources are listed as follows;

- **Is the organization credible?**

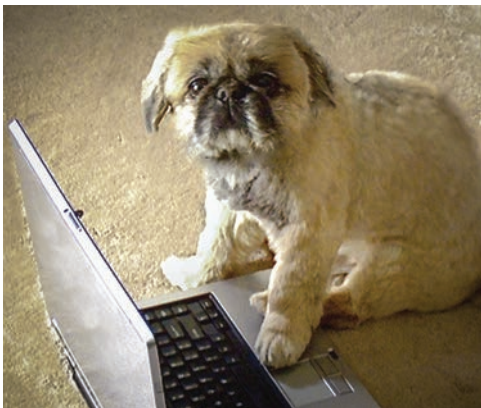


Figure 1.3 Who really updated that web page you are viewing?

Anyone can post anything on the Web! Choose your information sources wisely. First, evaluate the credibility of the website itself. Does it have its own domain name, such as <http://mywebsite.com>, or is it a free website consisting of just a folder of files hosted on a free web hosting site (such as weebly.com, awardspace.com, or 000webhost.com)? The URL of a free website usually includes part of the free web host's domain name. Information obtained from a website that has its own domain name will usually (but not always) be more reliable than information obtained from a free website.

Evaluate the type of domain name: Is it for a nonprofit organization (.org), a business (.com or .biz), or an educational institution (.edu)? Businesses may provide information in a biased manner, so be careful. Nonprofit organizations and schools will sometimes treat a subject more objectively.

- **How recent is the information?**

Another item to look at is the date the web page was created or last updated. Although some information is timeless, very often a web page that has not been updated for several years is outdated and may not be the best source of information.

- **Are there links to additional resources?**

Hyperlinks indicate websites with supporting or additional information that can be helpful to you in your research as you explore a topic. Look for these types of hyperlinks to aid your studies.

- **Is it Wikipedia?**

Wikipedia (<http://wikipedia.org>) is a good place to begin research, but don't accept what you read there for fact, and avoid using Wikipedia as a resource for academic assignments. Why? Well, except for a few protected topics, anyone can update Wikipedia with anything! Usually it all gets sorted out eventually—but be aware that the information you read may not be valid.

Feel free to use Wikipedia to begin exploring a topic, but then scroll down to the bottom of the Wikipedia web page and look for “References”—and then explore those websites and others that you may find. As you gather information on these sites, also consider the other criteria: credibility, domain name, timeliness, and links to additional resources.

Ethical Use of Information on the Web

This wonderful technology called the World Wide Web provides us with information, graphics, and music—all virtually free (after you pay your Internet service provider, of course). Let's consider the following issues relating to the ethical use of this information:

- Is it acceptable to copy someone's graphic to use on your own website?
- Is it acceptable to copy someone's website design to use on your own site or on a client's site?
- Is it acceptable to copy an essay that appears on a web page and use it, or parts of it, as your own writing?
- Is it acceptable to insult someone on your website or link to that person's site in a derogatory manner?

The answer to all these questions is no. Using someone's graphic without permission is the same as stealing it. In fact, if you link to it, you are actually using up some of the site's bandwidth and may be costing the owner money. Instead, ask the owner of the website for permission to use the graphic. If permission is granted, store the graphic on your own website and be sure to indicate the source of the graphic when you display it on your web page. The key is to request permission before using someone else's resources. Copying the website design of another person or company is also a form of stealing. Any text or graphic on a website is automatically copyrighted in the United States, regardless of whether a copyright symbol appears on the site or not. Insulting a person or company on your website or linking to the person's or company's website in a derogatory manner could be considered a form of defamation.

Issues like these, related to intellectual property, copyright, and freedom of speech, are regularly discussed and decided in courts of law. Good Web etiquette requires that you ask permission before using others' work, give credit for what you use (“fair use” in the U.S.



**Focus on
Ethics**

copyright law), and exercise your freedom of speech in a manner that is not harmful to others. The **World Intellectual Property Organization (WIPO)**, <http://wipo.int>, is dedicated to protecting intellectual property rights internationally.

What if you'd like to retain ownership, but make it easy for others to use or adapt your work? **Creative Commons**, <http://creativecommons.org>, is a nonprofit organization that provides free services that allow authors and artists to register a type of a copyright license called a Creative Commons license. There are several licenses to choose from, depending on the rights you wish to grant. The Creative Commons license informs others as to exactly what they can and cannot do with your creative work. See <http://meyerweb.com/eric/tools/color-blend> to view a web page licensed under a Creative Commons Attribution-ShareAlike 1.0 License.



Checkpoint 1.1

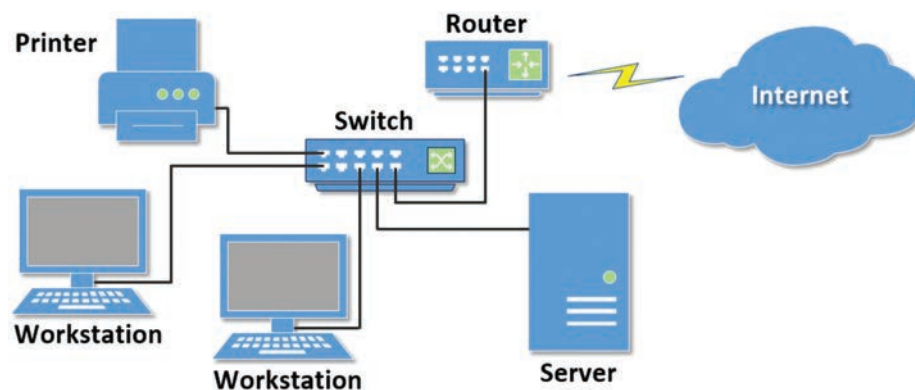
1. Describe the difference between the Internet and the Web.
2. Explain three events that contributed to the commercialization and exponential growth of the Internet.
3. Is the concept of universal design important to web developers? Explain your answer.

1.4 Network Overview

A **network** consists of two or more computers connected for the purpose of communicating and sharing resources. Common components of a network are shown in Figure 1.4 and include the following:

- Server computer(s)
- Client workstation computer(s)
- Shared devices such as printers
- Networking devices (routers, hubs, and switches) and the media that connect them

Figure 1.4
Common components of a network



The **clients** are the computer workstations used by individuals, such as a personal computer (PC) on a desk. The **server** receives requests from client computers for resources such as files. Computers used as servers are usually kept in a protected, secure area and are accessed only by network administrators. Networking devices such as hubs and switches provide network connections for computers, and routers direct information from one network to another. The **media** connecting the clients, servers, peripherals, and networking devices may consist of copper cables, fiber optic cables, or wireless technologies.

Networks vary in scale. A **local area network (LAN)** is usually confined to a single building or group of connected buildings. Your school computer lab may use a LAN. If you work in an office, you probably use a computer connected to a LAN. A **wide area network (WAN)** is geographically dispersed and usually uses some form of public or commercial communications network. For example, an organization with offices on both the East and West Coasts of the United States probably uses a WAN to provide a link between the LANs at each of the offices.

A **backbone** is a high-capacity communication link that carries data gathered from smaller links that interconnect with it. On the Internet, a backbone is a set of paths that local or regional networks connect to for long-distance interconnection. The Internet is a group of interconnected networks with very high-speed connectivity provided by the Internet backbones.

1.5 The Client/Server Model

The term **client/server** dates from the 1980s and refers to personal computers joined by a network. “Client/server” can also describe a relationship between two computer programs—the client and the server. The client requests some type of service (such as a file or database access) from the server. The server fulfills the request and transmits the results to the client over a network. While both the client and the server programs can reside on the same computer, typically they run on different computers (Figure 1.5). It is common for a server to handle requests from multiple clients.

The Internet is a great example of client/server architecture at work. Consider the following scenario: An individual is at a computer using a web browser client to access the Internet. The individual uses the web browser to visit a website, let’s say <http://www.yahoo.com>. The server is the web server program running on the computer with an IP address that corresponds to yahoo.com. It is contacted, locates the web page and related resources that were requested, and responds by sending them to the individual.

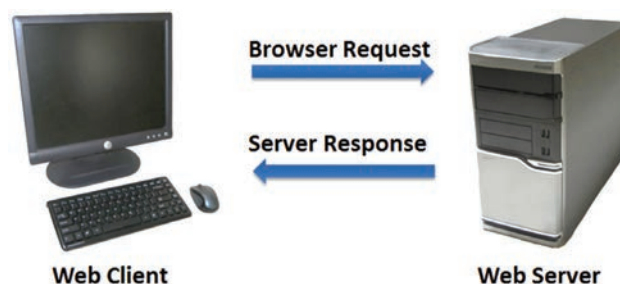


Figure 1.5 Web client and web server

Here's how to distinguish between web clients and web servers:

Web Client

- Connected to the Internet when needed
- Usually runs web browser (client) software such as Internet Explorer or Firefox
- Uses HTTP
- Requests web pages from a server
- Receives web pages and files from a server

Web Server

- Continually connected to the Internet
- Runs web server software (such as Apache or Internet Information Server)
- Uses HTTP
- Receives a request for the web page
- Responds to the request and transmits the status code, web page, and associated files

When clients and servers exchange files, they often need to indicate the type of file that is being transferred; this is done through the use of a MIME type. **Multipurpose Internet Mail Extensions (MIME)** are rules that allow multimedia documents to be exchanged among many different computer systems. MIME was initially intended to extend the original Internet e-mail protocol, but it is also used by HTTP. MIME provides for the exchange of seven different media types on the Internet: audio, video, image, application, message, multipart, and text. MIME also uses subtypes to further describe the data. The MIME type of a web page is text/html. MIME types of GIF and JPEG images are image/gif and image/jpeg, respectively.

A web server determines the MIME type of a file before the file is transmitted to the web browser. The MIME type is sent along with the document. The web browser uses the MIME type to determine how to display the document.

How does information get transferred from the web server to the web browser? Clients (such as web browsers) and servers (such as a web server) exchange information through the use of communication protocols such as HTTP, TCP, and IP, which are introduced in the next section.

1.6 Internet Protocols

Protocols are rules that describe how clients and servers communicate with each other over a network. There is no single protocol that makes the Internet and Web work; a number of protocols with specific functions are needed.

File Transfer Protocol (FTP)

File Transfer Protocol (FTP) is a set of rules that allow files to be exchanged between computers on the Internet. Unlike HTTP, which is used by web browsers to request web pages and their associated files in order to display a web page, FTP is used simply to move files

from one computer to another. Web developers commonly use FTP to transfer web page files from their computers to web servers. FTP is also commonly used to download programs and files from other servers to individual computers.

E-mail Protocols

Most of us take e-mail for granted, but there are two servers involved in its smooth functioning: an incoming mail server and an outgoing mail server. When you send e-mail to others, **Simple Mail Transfer Protocol (SMTP)** is used. When you receive e-mail, **Post Office Protocol** (POP; currently **POP3**) and **Internet Message Access Protocol (IMAP)** can be used.

Hypertext Transfer Protocol (HTTP)

HTTP is a set of rules for exchanging files such as text, images, audio, video, and other multimedia on the Web. Web browsers and web servers usually use this protocol. When the user of a web browser requests a file by typing a website address or clicking on a hyperlink, the browser builds an HTTP request and sends it to the server. The web server in the destination machine receives the request, does any necessary processing, and responds with the requested file and any associated files (such as image files, media files, and other related files).

Transmission Control Protocol/Internet Protocol (TCP/IP)

Transmission Control Protocol/Internet Protocol (TCP/IP) has been adopted as the official communication protocol of the Internet. TCP and IP have different functions that work together to ensure reliable communication over the Internet.

TCP

The purpose of **TCP** is to ensure the integrity of network communication. TCP starts by breaking files and messages into individual units called **packets**. These packets (see Figure 1.6) contain information such as the destination, source, sequence number, and checksum values used to verify the integrity of the data.



Figure 1.6 TCP packet

TCP is used together with IP to transmit files efficiently over the Internet. IP takes over after TCP creates the packets, using IP addressing to send each packet over the Internet via the best path at the particular time. When the destination address is reached, TCP verifies the integrity of each packet by using the checksum, requests a resend if a packet is damaged, and reassembles the file or message from the multiple packets.

IP

Working in harmony with TCP, **IP** is a set of rules that controls how data is sent between computers on the Internet. IP routes a packet to the correct destination address. Once sent, the packet gets successively forwarded to the next closest router (a hardware device designed to move network traffic) until it reaches its destination.

Each device connected to the Internet has a unique numeric **IP address**. These addresses consist of a set of four groups of numbers, called octets. The current version of IP, **Internet Protocol Version 4 (IPv4)**, uses 32-bit (binary digit) addressing. This results in a decimal number in the format of xxx.xxx.xxx.xxx, where each xxx is a value from 0 to 255. Theoretically, this system allows for at most 4 billion possible IP addresses (although many potential addresses are reserved for special uses). However, even this many addresses will not be enough to meet the needs of all of the devices expected to be connected to the Internet in upcoming years.

IP Version 6 (IPv6) will be the next standard IP protocol and will provide a huge increase in the number of possible addresses and many technological advances. IPv6 was designed as an evolutionary set of improvements to the current IPv4 and is backwardly compatible with it. Service providers and Internet users can update to IPv6 independently without having to coordinate with each other. IPv6 provides for more Internet addresses because the IP address is lengthened from 32 bits to 128 bits. This means that there are potentially 2^{128} unique IP addresses possible, or 340,282,366,920,938,463,463,347,607,431,768,211,456 addresses. (Now there will be enough IP addresses for everyone's PC, notebook, cell phone, tablet, toaster, and so on!)

The IP address of a device may correspond to a domain name. The **Domain Name System (DNS)** associates these IP addresses with the text-based URLs and domain names you type into a web browser address box. For example, at the time this book was written, one of Google's IP addresses was 173.194.116.72. You can enter this number in the address text box in a web browser (as shown in Figure 1.7), press Enter, and the Google home page will display. Of course, it's much easier to type "google.com," which is why domain names such as google.com were created in the first place! Since long strings of numbers are difficult for humans to remember, the Domain Name System was introduced as a way to associate text-based names with numeric IP addresses.

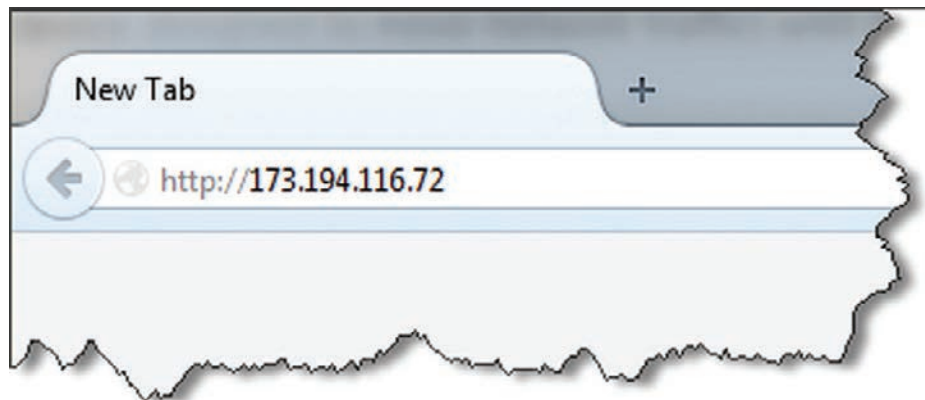


Figure 1.7 Entering an IP address in a web browser