

Instructor's Resource Manual

to

Programming the World Wide Web

Seventh Edition

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Preface

It is difficult to overestimate the effect the World Wide Web has had on the day-to-day lives of people, at least those in the developed countries. In fewer than 20 years, we have learned to use the Web for a myriad of disparate tasks, ranging from the mundane task of shopping for airline tickets to the crucial early-morning gathering of business news for a high-stakes day trader.

The speed at which millions of Web sites appeared in the last two decades would seem to indicate that the technologies used to build them were sitting on the shelf, fully developed and ready to use, even before the Web appeared. Also, one might guess that the tens of thousands of people who built those sites were sitting around unemployed, waiting for an opportunity and already possessing the knowledge and abilities required to carry out this mammoth construction task when it appeared. Neither of these was true. The need for new technologies was quickly filled by a large number of entrepreneurs, some at existing companies and some who started new companies. A large part of the programmer need was filled, at least to the extent to which it was filled, by new programmers, some straight from high school. Many, however, were previously employed by other sectors of the software development industry. All of them had to learn to use new languages and technologies.

A visit to a bookstore, either a bricks-and-mortar store or a Web site, will turn up a large variety of books on Web technologies aimed at the practicing professional. One difficulty encountered by those teaching courses in Web

programming technologies in colleges is the lack of textbooks that are targeted to their needs. Most of the books that discuss Web programming were written for professionals, rather than college students. Such books are written to fulfill the needs of professionals, which are quite different from those of college students. One major difference between an academic book and a professional book lies in the assumptions made by the author about the prior knowledge and experience of the audience. On the one hand, the backgrounds of professionals vary widely, making it difficult to assume much of anything. On the other hand, a book written for junior computer science majors can make some definite assumptions about the background of the reader.

This book is aimed at college students, not necessarily only computer science majors, but anyone who has taken at least two courses in programming. Although students are the primary target, the book is also useful for professional programmers who wish to learn Web programming.

The goal of the book is to provide the reader with a comprehensive introduction to the programming tools and skills required to build and maintain server sites on the Web. A wide variety of technologies are used in the construction of a Web site. There are now many books available for professionals that focus on these technologies. For example, there are dozens of books that specifically address only HTML. The same is true for at least a half-dozen other Web technologies. This book provides an overview of how the Web works, as well as descriptions of many of the most widely used Web technologies.

The first six editions of the book were used to teach a junior-level Web programming course at the University of Colorado at Colorado Springs. The challenge for students in the course is to learn to use several different programming languages and technologies in one semester. A heavy load of programming exercises is essential to the success of the course. Students in the course build a basic, static Web site, using only HTML as the first assignment. Throughout the remainder of the semester, they add features to their site as the new technologies are discussed in the course. Our students' prior course work in Java and data structures, as well as C and assembly language, is helpful, as is the fact that many of them have learned some HTML on their own before taking the course.

The most important prerequisite to the material of this book is a solid background in programming in some language that supports object-oriented programming. It is helpful to have some knowledge of a second programming language and a bit of UNIX, particularly if a UNIX-based Web server is used for the course. Familiarity with a second language makes learning the new languages easier.

Table of Contents

The book is organized into three parts: the introduction (Chapter 1), client-side technologies (Chapters 2–8), and server-side technologies (Chapters 9–15).

Chapter 1 lays the groundwork for the rest of the book. A few fundamentals are introduced, including the history and nature of the Internet, the World Wide Web, browsers, servers, URLs, MIME types, and HTTP. Also included in Chapter 1 are brief overviews of the most important topics of the rest of the book.

Chapter 2 provides an introduction to HTML, including images, links, lists, tables, and forms. Small examples are used to illustrate many of the HTML elements that are discussed in this chapter. A discussion of the parts of HTML5 that are now widely supported is included.

The topic of Chapter 3 is cascading style sheets, which provide the standard way of imposing style on the content specified in HTML tags. Because of the size and complexity of the topic, the chapter does not cover all of the aspects of style sheets. The topics discussed are levels of style sheets, style specification formats, selector formats, property values, and color. Among the properties covered are those for fonts, lists, and margins. Small examples are used to illustrate the subjects that are discussed.

Chapter 4 introduces the core of JavaScript, a powerful language that could be used for a variety of different applications. Our interest, of course, is its use in Web programming. Although JavaScript has become a large and complex language, we use the student's knowledge of programming in other languages to leverage the discussion, thereby providing a useful introduction to the language in a manageably small number of pages. Topics covered are the object model of JavaScript, its control statements, objects, arrays, functions, constructors, and pattern matching.

Chapter 5 discusses some of the features of JavaScript that are related to HTML documents. Included is the use of the basic and DOM 2 event and event-handling model, which can be used in conjunction with some of the elements of HTML documents. The HTML5 `canvas` element is introduced.

One of the interesting applications of JavaScript is building dynamic HTML documents with the Document Object Model (DOM). Chapter 6 provides descriptions of a collection of some of the changes that can be made to documents with the use of JavaScript and the DOM. Included are positioning elements; moving elements; changing the visibility of elements; changing the color, style, and size of text; changing the content of tags; changing the stacking order of overlapped elements; moving elements slowly; and dragging and dropping elements.

Chapter 7 presents an introduction to XML, which provides the means to design topic-specific markup languages that can be shared among users with common interests. Included are the syntax and document structure used by XML, data type definitions, namespaces, XML schemas, and the display of

XML documents with both cascading style sheets and XML transformations. Also included is an introduction to Web services and XML processors.

Chapter 8 introduces the Flash authoring environment, which is used to create a wide variety of visual and audio presentations—in particular, those that include animation. A series of examples is used to illustrate the development processes, including drawing figures, creating text, using color, creating motion and shape animations, adding sound tracks to presentations, and designing components that allow the user to control the Flash movie.

Chapter 9 introduces PHP, a server-side scripting language that enjoys wide popularity, especially as a database access language for Web applications. The basics of the language are discussed, as well as the use of cookies and session tracking. The use of PHP as a Web database access language is covered in Chapter 13.

Chapter 10 introduces Ajax, the relatively recent technology that is used to build Web applications with extensive user interactions that are more efficient than those same applications if they do not use Ajax. In addition to a thorough introduction to the concept and implementation of Ajax interactions, the chapter includes discussions of return document forms, Ajax toolkits, and Ajax security. Several examples are used to illustrate approaches to using Ajax.

Java Web software is discussed in Chapter 11. The chapter introduces the mechanisms for building Java servlets and gives several examples of how servlets can be used to present interactive Web documents. The NetBeans framework is introduced and used throughout the chapter. Support for cookies in servlets is presented and illustrated with an example. Then JSP is introduced through a series of examples, including the use of code-behind files. This discussion is followed by an examination of JavaBeans and JavaServer Faces, along with examples to illustrate their use.

Chapter 12 is an introduction to ASP.NET, although it begins with a brief introduction to the .NET Framework and C#. ASP.NET Web controls and some of the events they can raise and how those events can be handled are among the topics discussed in this chapter. ASP.NET AJAX is also discussed. Finally, constructing Web services with ASP.NET is introduced. Visual Studio is introduced and used to develop all ASP.NET examples.

Chapter 13 provides an introduction to database access through the Web. This chapter includes a brief discussion of the nature of relational databases, architectures for database access, the structured query language (SQL), and the free database system MySQL. Then, three approaches to Web access to databases are discussed: using PHP, using Java JDBC, and using ASP.NET. All three are illustrated with complete examples. All of the program examples in the chapter use MySQL.

Chapter 14 introduces the Ruby programming language. Included are the scalar types and their operations, control statements, arrays, hashes, methods, classes, code blocks and iterators, and pattern matching. There is, of course, much more to Ruby, but the chapter includes sufficient material to allow the student to use Ruby for building simple programs and Rails applications.

Chapter 15 introduces the Rails framework, designed to make the construction of Web applications relatively quick and easy. Covered are simple document requests, both static and dynamic, and applications that use databases, including the use of scaffolding.

Appendix A introduces Java to those who have experience with C++ and object-oriented programming, but who do not know Java. Such students can learn enough of the language from this appendix to allow them to understand the Java applets, servlets, JSP, and JDBC that appear in this book.

Appendix B is a list of 140 named colors, along with their hexadecimal codings.

Support Materials

Supplements for the book are available at Addison-Wesley's Web site www.pearsonhighered.com/cssupport. Support materials available to all readers of this book include

- A set of lecture notes in the form of PowerPoint files. The notes were developed to be the basis for class lectures on the book material.
- Code for example programs
- A Word document listing errors found in the book

Additional support material, including solutions to selected exercises and figures from the book, are available only to instructors adopting this textbook for classroom use. Contact your school's Pearson Education representative for information on obtaining access to this material, or visit pearsonhighered.com.

Software Availability

Most of the software systems described in this book are available free to students. These systems include browsers that provide interpreters for JavaScript and parsers for XML. Also, PHP, Ruby, and Java language processors, as well as the Rails framework, Java class libraries to support servlets, and Java JDBC, are available and free. ASP.NET is supported by the .NET software available from Microsoft. The Visual Web Developer 2010, a noncommercial version of Visual Studio, is available free from Microsoft. A free 30-day trial version of the Flash development environment is available from Adobe.

Differences between the Sixth Edition and the Seventh Edition

The seventh edition of this book differs significantly from the sixth.

The markup documents in the whole book were modified to reflect the change from XHTML 1.0 to HTML5. However, the XHTML syntax rules are used in all example documents.

Chapter 2 was revised to update the discussion for HTML, rather than XHTML 1.0. A section was added on some of the new elements in HTML5. Sections on `align`, `valign`, `cellpadding`, and `cellspacing` were removed. W3C validation was replaced by Total Validation.

Sections on contextual selectors and text spacing were removed from Chapter 3. All CSS sizes used in this chapter (and the remainder of the book) were changed from points to `em`.

A discussion of the HTML5 `canvas` element was added to Chapter 5.

Chapter 8 was revised to cover Flash 5.5, rather than Flash 4. Also, a section on importing graphic figures was added.

Chapter 11 was revised to use version 7 of the NetBeans development system, rather than 6.7. This required numerous changes.

Chapter 12 was revised to use Visual Studio 2010.

In Chapter 13, the discussion of the PHP/MySQL functions was revised to reflect the new version of these functions. The PHP/MySQL examples also were updated to use these new functions. The section on JDBC/MySQL was updated to use NetBeans 7.

Chapter 15 was revised to discuss the use of Rails 3.1 rather than Rails 2.4. This required extensive changes. Also, the discussion of Instant Rails was dropped, as was the section on Rails with Ajax.

Throughout the book, numerous small changes were made to improve the correctness and clarity of the material.

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Solutions to Selected Exercises

Chapter 2

Exercise 2.1

```
<!DOCTYPE html>
<!-- e2_1.html
      This is a solution to Exercise 2.1
-->
<html lang = "en">
<head>
  <title> Exercise 2.1 </title>
  <meta charset = "utf-8" />
</head>
<body>
<h2> Rupert B. Baggins </h2>
<p>
1321 Causeway Circle <br />
Middle, Earth <br />
rbaggins@miderth.net<br />
</p>
<hr />
<h3> Bush Watcher </h3>
<p>
<em> Forest Keepers, Limited </em> <br />
14 Cranberry Way <br />
Middle, Earth <br />
<strong> (no web site yet) </strong>
</p>
</body>
</html>
```

Exercise 2.3

```
<!DOCTYPE html">
<!-- e2_3.html
      This is a solution to Exercise 2.3
-->
<html lang = "en">
<head>
  <title> Exercise 2.3 </title>
  <meta charset = "utf-8" />
</head>
<body>
```



```

<h2> Rupert B. Baggins </h2>
<p>
1321 Causeway Circle <br />
Middle, Earth <br />
rbaggins@miderth.net<br /><br />
<a href = "e2_31.html"> Mr. Baggins' Background </a>
</p>
<hr />
<h3> Bush Watcher </h3>
<p>
<em> Forest Keepers, Limited </em> <br />
14 Cranberry Way <br />
Middle, Earth <br />
<strong> (no web site yet) </strong>
</p>
</body>
</html>

```

```

<!DOCTYPE html>
<!-- e2_31.html
      This is part of the solution to Exercise 2.3
      (The second document for the background info)
-->
<html lang = "en">
<head>
  <title> Exercise 2.3 (background) </title>
  <meta charset = "utf-8" />
</head>
<body>
<p>
Although we share the same family name, I am not in any way
related to the famous (or is it infamous) adventurer, Bilbo.
I have a lovely wife, Elvira, and two grown children, Max
and Miriam. Max has chosen to follow me in my profession,
which is described below. Miriam is a beekeeper for the town
bookkeeper, who keeps bees as a second job.
</p>
<p>
I am employed by Forest Keepers, Limited. My job, as I understand
it, is to keep an eye on the 4 acres of wild cranberries that
grow in the swamp at the edge of the village forest. I am required
to file a daily report, in triplicate, on the condition of the
cranberry bushes. To accomplish my task, I walk by and inspect
every cranberry bush in the swamp every workday. My employer provides
me with wading boots for my job. I pick up the boots at the office
every weekday morning and turn them back in, after a thorough
cleaning, after each workday.
</p>
</body>
</html>

```

Exercise 2.4

```

<!DOCTYPE html>

```

```

<!-- e2_4.html
      A solution to Exercise 2.4 - an unordered list
-->
<html lang = "en">
<head>
  <title> Unordered List </title>
  <meta charset = "utf-8" />
</head>
<body>
<h3> Grocery List </h3>
<ul>
  <li> milk - 2%, 2 gallons </li>
  <li> bread - butter top wheat </li>
  <li> cheddar cheese - sharp, 1 lb. </li>
  <li> soup - vegetable beef, 3 cans </li>
  <li> hamburger - 80% fat free, 2 lbs. </li>
  <li> orange juice - not from concentrate, 1/2 gallon </li>
  <li> eggs - large, 1 dozen </li>
</ul>
</body>
</html>

```

Exercise 2.8

```

<!DOCTYPE html>
<!-- e2_8.html
      A solution to Exercise 2.8 - a nested, ordered list
-->
<html lang = "en">
<head>
  <title> An Ordered List </title>
  <meta charset = "utf-8" />
</head>
<body>
<h3> My Uncles, Aunts, and Cousins </h3>
<ol>
  <li> Violet Vinelli (my mother) </li>
  <li> Frederick Vinelli
    <ol>
      <li> Mary Vinelli </li>
      <li> Betty Ann Boop </li>
      <li> Bob Vinelli </li>
      <li> Roger Vinelli </li>
    </ol>
  </li>
  <li> Maxine Robinson
    <ol>
      <li> John Robinson </li>
      <li> Patty Robinson </li>
      <li> Lucille Robinson </li>
    </ol>
  </li>
  <li> Thomas Vinelli
    <ol>
      <li> Albert Vinelli </li>

```

```

        <li> Alison MacKinsey </li>
        <li> Alton Vinelli </li>
    </ol>
</li>
</ol>

<ol>
    <li> Albert Alphonso (my father) </li>
    <li> Herbert Alphonso
        <ol>
            <li> Louise Alphonso </li>
            <li> Pam Alphonso </li>
            <li> Fred Alphonso </li>
        </ol>
    </li>
    <li> Ann Marie Predicate
        <ol>
            <li> George Predicate </li>
            <li> Michael Predicate </li>
            <li> Darcie Predicate </li>
        </ol>
    </li>
    <li> Ferdinand Alphonso
        <ol>
            <li> Noah Alphonso </li>
            <li> Leah Alphonso </li>
            <li> Jo Alphonso </li>
        </ol>
    </li>
</ol>
</body>
</html>

```

Exercise 2.9

```

<!DOCTYPE html>
<!-- e2_9.html
    A solution to Exercise 2.9 - a simple table
-->
<html lang = "en">
<head>
    <title> A simple table </title>
    <meta charset = "utf-8" />
</head>
<body>
<table>
<caption> Trees </caption>
    <tr>
        <th> </th>
        <th> Pine </th>
        <th> Maple </th>
        <th> Oak </th>
        <th> Fir </th>
    </tr>
    <tr>

```

```

        <th> Average Height (feet) </th>
        <td> 55 </td>
        <td> 50 </td>
        <td> 50 </td>
        <td> 65 </td>
</tr>
<tr>
    <th> Average Width (inches) </th>
    <td> 18 </td>
    <td> 26 </td>
    <td> 24 </td>
    <td> 28 </td>
</tr>
<tr>
    <th> Typical Lifespan (years) </th>
    <td> 150 </td>
    <td> 230 </td>
    <td> 310 </td>
    <td> 135 </td>
</tr>
<tr>
    <th> Leaf Type </th>
    <td> Long needles </td>
    <td> Broadleaf </td>
    <td> Split leaf </td>
    <td> Short needles </td>
</tr>
</table>
</body>
</html>

```

Exercise 2.10

```

<!DOCTYPE html>
<!-- e2_10.html
    A solution to Exercise 2.10 - a simple table
-->
<html lang = "en">

<head>
    <title> A simple table </title>
    <meta charset = "utf-8" />
</head>
<body>
<table>
<caption> Tree Characteristics </caption>
    <tr>
        <td rowspan = "2" colspan = "2"> </td>
        <th colspan = "4"> Tree </th>
    </tr>
    <tr>
        <th> Pine </th>
        <th> Maple </th>
        <th> Oak </th>
        <th> Fir </th>

```

```

</tr>
<tr>
  <th rowspan = "4"> Characteristic </th>
  <th> Average Height (feet) </th>
  <td> 55 </td>
  <td> 50 </td>
  <td> 50 </td>
  <td> 65 </td>
</tr>
<tr>
  <th> Average Width (inches) </th>
  <td> 18 </td>
  <td> 26 </td>
  <td> 24 </td>
  <td> 28 </td>
</tr>
<tr>
  <th> Typical Lifespan (years) </th>
  <td> 150 </td>
  <td> 230 </td>
  <td> 310 </td>
  <td> 135 </td>
</tr>
<tr>
  <th> Leaf Type </th>
  <td> Long needles </td>
  <td> Broadleaf </td>
  <td> Split leaf </td>
  <td> Short needles </td>
</tr>
</table>
</body>
</html>

```

Exercise 2.17

```

<!DOCTYPE html>
<!-- e2_17.html
  A solution to Exercise 2.17 - a revision of 2.8 with headers
  and footers
-->
<html lang = "en">
<head>
  <title> An Ordered List </title>
  <meta charset = "utf-8" />
</head>
<body>
<header>
  <h2> Bob's Relatives </h2>
  <h3> (Uncles, Aunts, and Cousins) </h3>
</header>
<ol>
  <li> Violet Vinelli (my mother) </li>
  <li> Frederick Vinelli
    <ol>

```

```

        <li> Mary Vinelli </li>
        <li> Betty Ann Boop </li>
        <li> Bob Vinelli </li>
        <li> Roger Vinelli </li>
    </ol>
</li>
<li> Maxine Robinson
    <ol>
        <li> John Robinson </li>
        <li> Patty Robinson </li>
        <li> Lucille Robinson </li>
    </ol>
</li>
<li> Thomas Vinelli
    <ol>
        <li> Albert Vinelli </li>
        <li> Alison MacKinsey </li>
        <li> Alton Vinelli </li>
    </ol>
</li>
</ol>

<ol>
    <li> Albert Alphonso (my father) </li>
    <li> Herbert Alphonso
        <ol>
            <li> Louise Alphonso </li>
            <li> Pam Alphonso </li>
            <li> Fred Alphonso </li>
        </ol>
    </li>
    <li> Ann Marie Predicate
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