

Preface

*Science and technology and the various forms of art,
all unite humanity in a single and interconnected system.*

—Zhores Aleksandrovich Medvede

Welcome to Internet and web programming and *Internet & World Wide Web How to Program, Fourth Edition*! At Deitel & Associates, we write programming language textbooks and professional books for Prentice Hall, deliver corporate training worldwide and develop Web 2.0 Internet businesses. The book has been substantially reworked to reflect today's Web 2.0 Rich Internet Application-development methodologies. We have significantly tuned each of the chapters and added new chapters on some of the latest technologies.

New and Updated Features

Here's a list of updates we've made to the fourth edition of *Internet & World Wide Web How to Program*:

- Substantially reworked to reflect today's Web 2.0 Rich Internet Application-development methodologies.
- Coverage of the two leading web browsers—Internet Explorer 7 and Firefox 2. All client-side applications in the book run correctly on both browsers.
- New focus on Web 2.0 technologies and concepts.
- New chapter on Web 2.0 and Internet Business (reviewed by leaders in the Web 2.0 community).
- New focus on building Rich Internet Applications with the interactivity of desktop applications.
- New chapter on building Ajax-enabled web applications, with applications that demonstrate partial-page updates and type-ahead capabilities.
- New chapter on Adobe Flex—a Rich Internet Application framework for creating scalable, cross-platform, multimedia-rich applications for delivery within the enterprise or across the Internet.
- New chapter on Microsoft Silverlight (a competitor to Adobe Flash and Flex)—a cross-browser and cross-platform plug-in for delivering .NET-based Rich Internet Applications that include audio, video and animations over the web.
- New chapter on rapid applications development of database-driven web applications with Ruby on Rails; also, discusses developing Ajax applications with the included Prototype and Script.aculo.us libraries.
- Updated chapter on Adobe Dreamweaver CS3 (Creative Suite 3), including new sections on CSS integration and the Ajax-enabled Spry framework.

- Updated chapters on Adobe Flash CS3, including a chapter on building a computer game.
- Significantly enhanced treatments of XHTML DOM manipulation and JavaScript events.
- Significantly enhanced treatment of XML DOM manipulation with JavaScript.
- New chapter on building SOAP-based web services with Java and REST-based web services with ASP.NET (using Visual Basic).
- Upgraded and enhanced the PHP chapter to PHP 5.
- Updated ASP.NET 1.1 coverage to ASP.NET 2.0, featuring ASP.NET Ajax.
- New JavaServer Faces (JSF) coverage emphasizing building Ajax-enabled JSF applications (replaces Servlets and JavaServer Pages).
- Client-side case studies that enable students to interact with preimplemented server-side applications and web services that we host at test.deitel.com.
- Several new and updated case studies including Deitel Cover Viewer (JavaScript/DOM), Address Book (Ajax), Cannon Game (Flash), Weather/Yahoo! Maps Mashup (Flex), Movie Player (Silverlight), Mailing List (PHP/MySQL), Message Forum and Flickr Photo Viewer (Ruby on Rails), Guest Book and Secure Books Database (ASP.NET), Address Book with Google Maps (JavaServer Faces) and Blackjack (JAX-WS web services).
- The Perl 5 and Python chapters from the previous edition of this book are posted in PDF form at www.deitel.com/books/iw3htp4/.

All of this has been carefully reviewed by distinguished academics and industry developers.

We believe that this book and its support materials will provide students and professionals with an informative, interesting, challenging and entertaining Internet and web programming educational experience. The book includes a suite of ancillary materials that help instructors maximize their students' learning experience.

If you have questions as you read this book, send an e-mail to deitel@deitel.com—we'll respond promptly. For updates on the book and the status of all supporting software, and for the latest news on Deitel publications and services, visit www.deitel.com. Sign up at www.deitel.com/newsletter/subscribe.html for the free *Deitel*[®] *Buzz Online* e-mail newsletter and check out www.deitel.com/ResourceCenters.html for our growing list of Internet and web programming, Internet business, Web 2.0 and related Resource Centers. Each week we announce our latest Resource Centers in the newsletter. Please let us know of other Resource Centers you'd like to see.

Dependency Chart

Figure 1 illustrates the dependencies that exist between chapters in the book. An arrow pointing into a chapter indicates that the chapter depends on the content of the chapter from which the arrow points. For example, Chapter 28, Web Services, depends on both Chapters 25 and 27. We recommend that you study all of a given chapter's dependencies before studying that chapter, though other orders are certainly possible. Some of the dependencies apply only to sections of chapters, so we advise readers to browse the material before designing a course of study. We've also commented on some additional dependen-

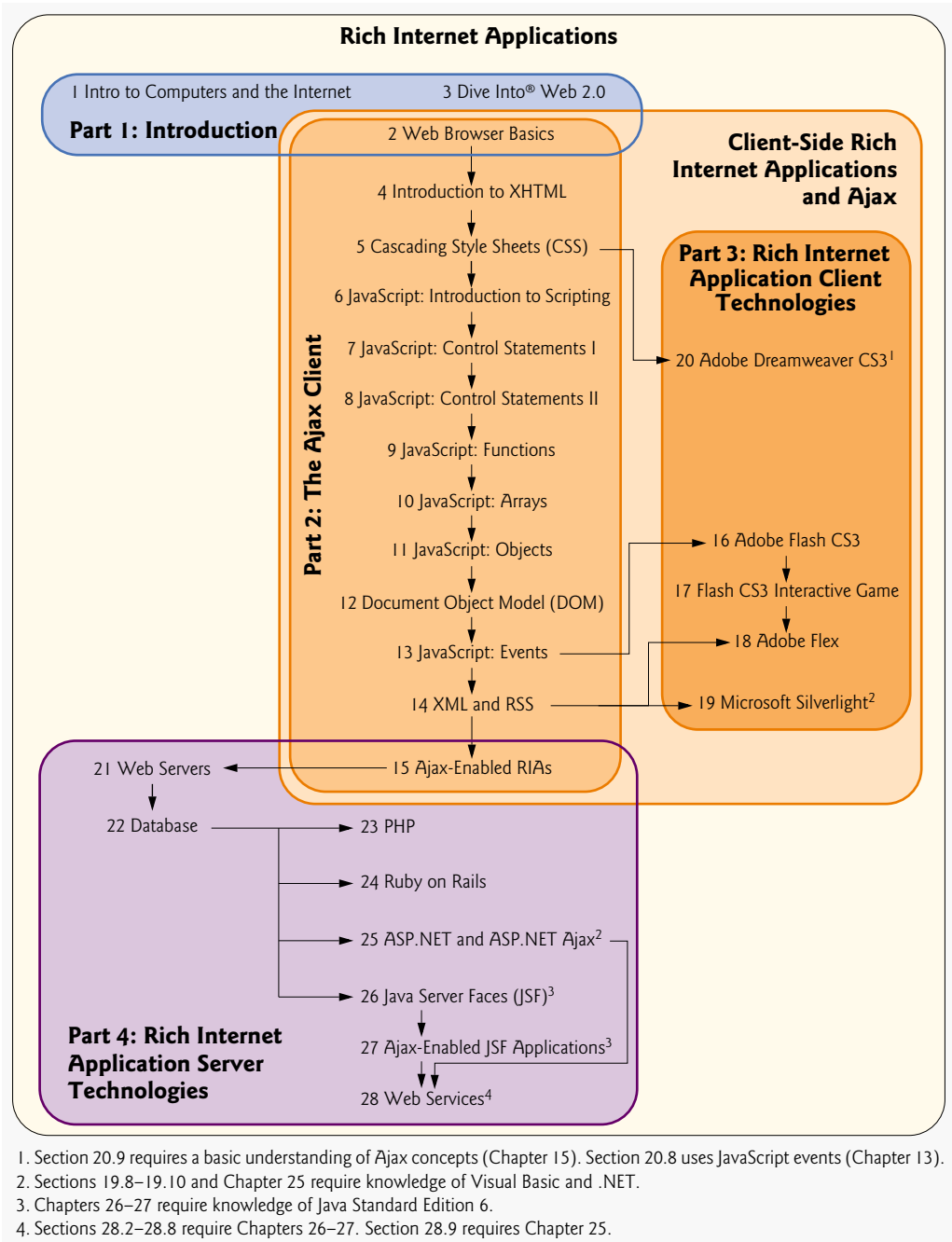


Fig. 1 | *Internet & World Wide Web How to Program, 4/e* chapter dependency chart.

cies in the diagram’s footnotes. This book is widely used in courses that teach pure client-side web programming, courses that teach pure server-side web programming, and courses

that mix and match some client-side and some server-side web programming. Curricula for courses in web programming are still evolving, and many syllabi exist to organize the material in this book. You can search the web for “syllabus,” “Internet,” “web” and “Deitel” to find syllabi currently used with this book. Readers interested in studying server-side technologies should understand how to build web pages using XHTML, CSS and object-based programming in JavaScript. Note the positioning of XML and Ajax in the dependency chart—these can be taught as part of a client-side unit, at the beginning of a server-side unit or split between the two.

Teaching Approach

Internet & World Wide Web How to Program, 4/e contains a rich collection of examples. The book concentrates on the principles of good software engineering and stresses program clarity. We teach by example. We are educators who teach leading-edge topics in industry classrooms worldwide. Dr. Harvey M. Deitel has 20 years of college teaching experience and 18 years of industry teaching experience. Paul Deitel has 16 years of industry teaching experience. The Deitels have taught courses at all levels to government, industry, military and academic clients of Deitel & Associates.

Live-Code Approach. *Internet & World Wide Web How to Program, 4/e* is loaded with “live-code” examples—each new concept is presented in the context of a complete working web application that is immediately followed by one or more screen captures showing the application’s functionality. This style exemplifies the way we teach and write about programming; we call this the “live-code approach.”

Syntax Coloring. We syntax color all the code, similar to the way most integrated-development environments and code editors syntax color code. This improves code readability—an important goal, given that this book contains about 18,000 lines of code in complete, working programs. Our syntax-coloring conventions are as follows:

```

comments appear in green
keywords appear in dark blue
PHP, Ruby, ASP.NET and JSP delimiters, and errors appear in red
constants and literal values appear in light blue
all other code appears in black

```

Code Highlighting. We place gray rectangles around the key code segments in each program.

Using Fonts and Colors for Emphasis. We place the key terms and the index’s page reference for each defining occurrence in **bold blue** text for easier reference. We emphasize on-screen components in the **bold Helvetica** font (e.g., the **File** menu) and emphasize program text in the Lucida font (e.g., `int x = 5`).

Web Access. All of the source-code examples for *Internet & World Wide Web How to Program, 4/e* are available for download from:

www.deitel.com/books/iw3http4/

Site registration is quick, easy and free. Download all the examples, then run each program as you read the corresponding text discussions. Making changes to the examples and seeing

the effects of those changes is a great way to enhance your Internet and web programming learning experience.

Objectives. Each chapter begins with a statement of objectives. This lets you know what to expect and gives you an opportunity to determine if you have met the objectives after reading the chapter.

Quotations. The learning objectives are followed by quotations. Some are humorous; some are philosophical; others offer interesting insights. We hope that you enjoy relating the quotations to the chapter material.

Outline. The chapter outline helps you approach the material in a top-down fashion, so you can anticipate what is to come and set a comfortable learning pace.

Illustrations/Figures. Abundant charts, tables, line drawings, programs and program output are included.

Programming Tips. We include programming tips to help you focus on important aspects of program development. These tips and practices represent the best we have gleaned from a combined six decades of programming and teaching experience. One of our students—a mathematics major—told us that she feels this approach is like the highlighting of axioms, theorems and corollaries in mathematics books—it provides a basis on which to build good software.



Good Programming Practices

Good Programming Practices *call attention to techniques that will help you produce programs that are clearer, more understandable and more maintainable.*



Common Programming Errors

Students tend to make certain kinds of errors frequently. Pointing out these Common Programming Errors *reduces the likelihood that you'll make the same mistakes.*



Error-Prevention Tips

These tips contain suggestions for exposing bugs and removing them from your programs; many describe aspects of programming that prevent bugs from getting into programs in the first place.



Performance Tips

Students like to “turbo charge” their programs. These tips highlight opportunities for making your programs run faster or minimizing the amount of memory that they occupy.



Portability Tips

We include Portability Tips to help you write code that will run on a variety of platforms and to explain how to achieve a high degree of portability.



Software Engineering Observations

The Software Engineering Observations *highlight architectural and design issues that affect the construction of software systems, especially large-scale systems.*

Wrap-Up Section. Each chapter ends with a brief “wrap-up” section that recaps the chapter content and transitions to the next chapter.

Summary Bullets. Each chapter ends with additional pedagogic features. We present a thorough, bulleted-list-style summary of the chapter, section by section.

Terminology. We include an alphabetized list of the important terms defined in each chapter. Each term also appears in the index, with its defining occurrence highlighted with a **bold, blue** page number.

Self-Review Exercises and Answers. Extensive self-review exercises and answers are included for self-study.

Exercises. Each chapter concludes with a substantial set of exercises, including simple recall of important terminology and concepts; writing individual statements; writing complete functions and scripts; and writing major term projects. The large number of exercises enables instructors to tailor their courses to the unique needs of their students and to vary course assignments each semester. Instructors can use these exercises to form homework assignments, short quizzes, major examinations and term projects. See our Programming Projects Resource Center (www.deitel.com/ProgrammingProjects/) for many additional exercise and project possibilities.

[NOTE: Please do not write to us requesting access to the Prentice Hall Instructor's Resource Center. Access is limited strictly to college instructors teaching from the book. Instructors may obtain access only through their Pearson representatives.]

Thousands of Index Entries. We have included an extensive index which is especially useful when you use the book as a reference.

"Double Indexing" of Live-Code Examples. For every source-code program in the book, we index the figure caption both alphabetically and as a subindex item under "Examples." This makes it easier to find examples using particular features.

Bibliography. An extensive bibliography of books, articles and online documentation is included to encourage further reading.

Student Resources Included with *Internet & World Wide Web How to Program, 4/e*

Many Internet and web development tools are available. We wrote *Internet & World Wide Web How to Program, 4/e* using Internet Explorer 7, Firefox 2 and other free-for-download software. Additional resources and software downloads are available in our Internet and Web programming related Resource Centers:

www.deitel.com/resourcecenters.html/

and at the website for this book:

www.deitel.com/books/iw3http4/

Instructor Resources for *Internet & World Wide Web How to Program, 4/e*

Internet & World Wide Web How to Program, 4/e has extensive instructor resources. The Prentice Hall *Instructor's Resource Center* contains the *Solutions Manual* with solutions to the end-of-chapter exercises, a *Test Item File* of multiple-choice questions (approximately

two per book section) and PowerPoint® slides containing all the code and figures in the text, plus bulleted items that summarize the key points in the text. Instructors can customize the slides. If you are not already a registered faculty member, contact your Pearson representative or visit vig.prenhall.com/replocator/.

Deitel® Buzz Online Free E-mail Newsletter

Each week, the *Deitel® Buzz Online* newsletter announces our latest Resource Center(s) and includes commentary on industry trends and developments, links to free articles and resources from our published books and upcoming publications, product-release schedules, errata, challenges, anecdotes, information on our corporate instructor-led training courses and more. It's also a good way for you to keep posted about issues related to *Internet & World Wide Web How to Program, 4/e*. To subscribe, visit

www.deitel.com/newsletter/subscribe.html

The Deitel Online Resource Centers

Our website, www.deitel.com, provides Resource Centers on various topics including programming languages, software, Web 2.0, Internet business and open source projects (Fig. 2). The Resource Centers have evolved out of the research we do to support our books and business endeavors. We've found many exceptional resources including tutorials, documentation, software downloads, articles, blogs, podcasts, videos, code samples, books, e-books and more. Most of them are free. In the spirit of Web 2.0, we share these resources with the worldwide community. The Deitel Resource Centers are a starting point for your own research. We help you wade through the vast amount of content on the Internet by providing links to the most valuable resources. Each week we announce our latest Resource Centers in the *Deitel® Buzz Online* (www.deitel.com/newsletter/subscribe.html).

Acknowledgments

It is a great pleasure to acknowledge the efforts of many people whose names may not appear on the cover, but whose hard work, cooperation, friendship and understanding were crucial to the production of the book. Many people at Deitel & Associates, Inc. devoted long hours to this project—thanks especially to Abbey Deitel and Barbara Deitel.

We'd also like to thank the participants in our Honors Internship program who contributed to this publication—Andrew Faden, a computer engineering major at Northeastern University; Scott Wehrwein, a computer science major at Middlebury College; Ilana Segall, a mathematical and computational science major at Stanford University; Mark Kagan, a computer science, economics and math major at Brandeis University; Jennifer Fredholm, an English and computer science major at New York University; Jessica Henkel, a psychology major and business minor at Northeastern University; and Kyle Banks, a computer science and business major at Northeastern University.

We are fortunate to have worked on this project with the talented and dedicated team of publishing professionals at Prentice Hall. We appreciate the extraordinary efforts of Marcia Horton, Editorial Director of Prentice Hall's Engineering and Computer Science Division. Carole Snyder and Dolores Mars did a remarkable job recruiting the book's large review team and managing the review process. Francesco Santalucia (an independent artist)

Deitel Resource Centers		
<i>Web 2.0 and Internet Business</i>	Linux	Java EE 5
Affiliate Programs	MySQL	Java SE 6
Alert Services	Open Source	JavaFX
Attention Economy	Perl	JavaScript
Blogging	PHP	JSON
Building Web Communities	Python	OpenGL
Community-Generated Content	Ruby	Perl
Google AdSense	Ruby on Rails	PHP
Google Analytics	<i>Software</i>	Programming Projects
Google Base	Apache	Python
Google Services	DotNetNuke (DNN)	Ruby
Google Video	Eclipse	Ruby on Rails
Google Web Toolkit	Firefox	Silverlight
Internet Advertising	Flash CS3 (Flash 9)	Visual Basic
Internet Business Initiative	Internet Explorer 7	Visual C++
Internet Public Relations	Linux	Web Services
Internet Video	MySQL	Web 3D Technologies
Joost	Open Source	XHTML
Link Building	Search Engines	XML
Location-Based Services	Web Servers	<i>Java</i>
Mashups	Wikis	Java
Microformats	Windows Vista	Java Certification and Assessment Testing
Podcasting	<i>Programming</i>	Java Design Patterns
Recommender Systems	.NET	Java EE 5
RSS	.NET 3.0	Java SE 6
Search Engine Optimization	Adobe Flex	JavaFX
Selling Digital Content	Ajax	<i>Microsoft</i>
Sitemaps	Apex On-Demand Programming Language	.NET
Skype	ASP.NET	.NET 3.0
Social Media	ASP.NET Ajax	ASP.NET
Social Networking	C	ASP.NET Ajax
Software as a Service (SaaS)	C#	C#
Virtual Worlds	C++	DotNetNuke (DNN)
Web 2.0	C++ Boost Libraries	Internet Explorer 7
Web 3.0	C++ Game Programming	Silverlight
Web Analytics	Code Search Engines and Code Sites	Visual Basic
Website Monetization	Computer Game Programming	Visual C++
Widgets	CSS 2.1	Windows Vista
<i>Open Source and LAMP Stack</i>	Dojo	<i>Other Topics</i>
Apache	Flash 9	Computer Games
DotNetNuke (DNN)	Java	Computing Jobs
Eclipse	Java Certification and Assessment Testing	Gadgets and Gizmos
Firefox	Java Design Patterns	Sudoku

Fig. 2 | Deitel Resource Centers www.deitel.com/resourcecenters.html

and Kristine Carney of Prentice Hall did a wonderful job designing the book's cover; we provided the concept, and they made it happen. Vince O'Brien, Scott Disanno, Bob Engelhardt and Marta Samsel did a marvelous job managing the book's production.

We wish to acknowledge the efforts of our reviewers. Adhering to a tight time schedule, they scrutinized the text and the programs, providing countless suggestions for improving the accuracy and completeness of the presentation.

We sincerely appreciate the efforts of our third edition post-publication reviewers and our fourth edition reviewers:

Internet & World Wide Web How to Program, 4/e Reviewers

Roland Bouman (MySQL AB), Chris Bowen (Microsoft), Peter Brandano (KoolConnect Technologies, Inc.), Matt Chotin (Adobe), Chris Cornutt (PHPDeveloper.org), Phil Costa (Adobe), Umachitra Damodaran (Sun Microsystems), Vadiraj Deshpande (Sun Microsystems), Justin Erenkrantz (The Apache Software Foundation), Christopher Finke (Netscape), Jesse James Garrett (Adaptive Path), Mike Harsh (Microsoft), Kevin Henriksen (Zimbra.com), Tim Heuer (Microsoft), Molly E. Holtzschlag (W3C), Ralph Hooper (University of Alabama, Tuscaloosa), John Hrvatin (Microsoft), Johnvey Hwang (Splunk, Inc.), Joe Kromer (New Perspective and the Pittsburgh Adobe Flash Users Group), Eric Lawrence (Microsoft), Pete LePage (Microsoft), Billy B. L. Lim (Illinois State University), Shobana Mahadevan (Sun Microsystems), Patrick Mineault (Freelance Flash Programmer), Anand Narayanaswamy (Microsoft), Tim O'Reilly (O'Reilly Media, Inc.), John Peterson (Insync and V.I.O., Inc.), Jennifer Powers (University of Albany), Robin Schumacher (MySQL AB), José Antonio González Seco (Parlamento de Andalucía), Dr. George Semeczko (Royal & SunAlliance Insurance Canada), Steven Shaffer (Penn State University), Karen Tegtmeyer (Model Technologies, Inc.), Paul Vencill (MITRE), Raymond Wen (Microsoft), Eric M. Wendelin (Auto-trol Technology Corporation), Raymond F. Wisman (Indiana University) and Daniel Zappala (Brigham Young University).

Internet & World Wide Web How to Program, 3/e Reviewers

Americ Azevedo (University of California at Berkeley), Tim Buntel (Macromedia, Inc.), Sylvia Candelaria de Ram (Cognizor, LLC; HumanMarkup.org), Wesley J. Chun (CyberWeb Consulting), Marita Ellixson (Eglin AFB), Jay Glynn (American General AIG), James Greenwood (Poulnet), Timothy Greer (Middle Tennessee State University), James Huddleston (Independent Consultant), Lynn Kyle (Yahoo!, Inc.), Dan Livingston (Independent Consultant), Oge Marques (Florida Atlantic University), Mark Merkow (American Express Technologies), Dan Moore (Independent Consultant), George Semeczko (Royal & Sun Alliance Insurance Canada), Deborah Shapiro (Cittone Institutes), Matt Smith (Institute of Technology at Blanchardstown), Narayana Rao Surapaneni (Patri Computer Systems Limited), Stephanie Tauber (Tufts University), Yateen Thakkar (Syntel India, Ltd.), Cynthia Waddell (International Center for Disability Resources on the Internet), Loran Walker (Lawrence Technological University) and Alnisa White (ILL Designs).

Well, there you have it! Welcome to the exciting world of Internet and web programming in a Web 2.0 world. We hope you enjoy this look at contemporary computer programming. Good luck! As you read the book, we would sincerely appreciate your

comments, criticisms, corrections and suggestions for improving the text. Please address all correspondence to:

deitel@deitel.com

We'll respond promptly, and post corrections and clarifications at:

www.deitel.com/books/iw3http4/

We hope you enjoy reading *Internet & World Wide Web How to Program, Fourth Edition* as much as we enjoyed writing it!

Paul J. Deitel

Dr. Harvey M. Deitel

Maynard, Massachusetts

August 2007

About the Authors

Paul J. Deitel, CEO and Chief Technical Officer of Deitel & Associates, Inc., is a graduate of MIT's Sloan School of Management, where he studied Information Technology. He holds the Java Certified Programmer and Java Certified Developer certifications, and has been designated by Sun Microsystems as a Java Champion. Through Deitel & Associates, Inc., he has delivered Java, C, C++, C# and Visual Basic courses to industry clients, including IBM, Sun Microsystems, Dell, Lucent Technologies, Fidelity, NASA at the Kennedy Space Center, the National Severe Storm Laboratory, White Sands Missile Range, Rogue Wave Software, Boeing, Stratus, Cambridge Technology Partners, Open Environment Corporation, One Wave, Hyperion Software, Adra Systems, Entergy, CableData Systems, Nortel Networks, Puma, iRobot, Invensys and many more. He has also lectured on Java and C++ for the Boston Chapter of the Association for Computing Machinery. He and his father, Dr. Harvey M. Deitel, are the world's best-selling programming language textbook authors.

Dr. Harvey M. Deitel, Chairman and Chief Strategy Officer of Deitel & Associates, Inc., has 45 years of academic and industry experience in the computer field. Dr. Deitel earned B.S. and M.S. degrees from MIT and a Ph.D. from Boston University. He has 20 years of college teaching experience, including earning tenure and serving as the Chairman of the Computer Science Department at Boston College before founding Deitel & Associates, Inc., with his son, Paul J. Deitel. He and Paul are the co-authors of several dozen books and multimedia packages and they are writing many more. With translations published in Japanese, German, Russian, Spanish, Traditional Chinese, Simplified Chinese, Korean, French, Polish, Italian, Portuguese, Greek, Urdu and Turkish, the Deitels' texts have earned international recognition. Dr. Deitel has delivered hundreds of professional seminars to major corporations, academic institutions, government organizations and the military.

About Deitel & Associates, Inc.

Deitel & Associates, Inc., is an internationally recognized corporate training and content-creation organization specializing in computer programming languages, Internet and web software technology, object technology education and Internet business development

through its Web 2.0 Internet Business Initiative. The company provides instructor-led courses on major programming languages and platforms, such as C++, Java, Advanced Java, C, C#, Visual C++, Visual Basic, XML, object technology and Internet and web programming. The founders of Deitel & Associates, Inc., are Dr. Harvey M. Deitel and Paul J. Deitel. The company's clients include many of the world's largest companies, government agencies, branches of the military, and academic institutions. Through its 31-year publishing partnership with Prentice Hall, Deitel & Associates, Inc. publishes leading-edge programming textbooks, professional books, interactive multimedia *Cyber Classrooms*, *Complete Training Courses*, Web-based training courses, online and offline video courses, and e-content for the popular course management systems WebCT, Blackboard and Pearson's CourseCompass. Deitel & Associates, Inc., and the authors can be reached via e-mail at:

deitel@deitel.com

To learn more about Deitel & Associates, Inc., its publications and its worldwide *Dive Into*[®] Series Corporate Training curriculum, visit:

www.deitel.com

and subscribe to the free *Deitel*[®] *Buzz Online* e-mail newsletter at:

www.deitel.com/newsletter/subscribe.html

Check out the growing list of online Deitel Resource Centers at:

www.deitel.com/resourcecenters.html

Individuals wishing to purchase Deitel publications can do so through:

www.deitel.com/books/index.html

Bulk orders by corporations, the government, the military and academic institutions should be placed directly with Prentice Hall. For more information, visit

www.prenhall.com/misctm/support.html#order