

15th Edition

Understanding Computers

Today and Tomorrow

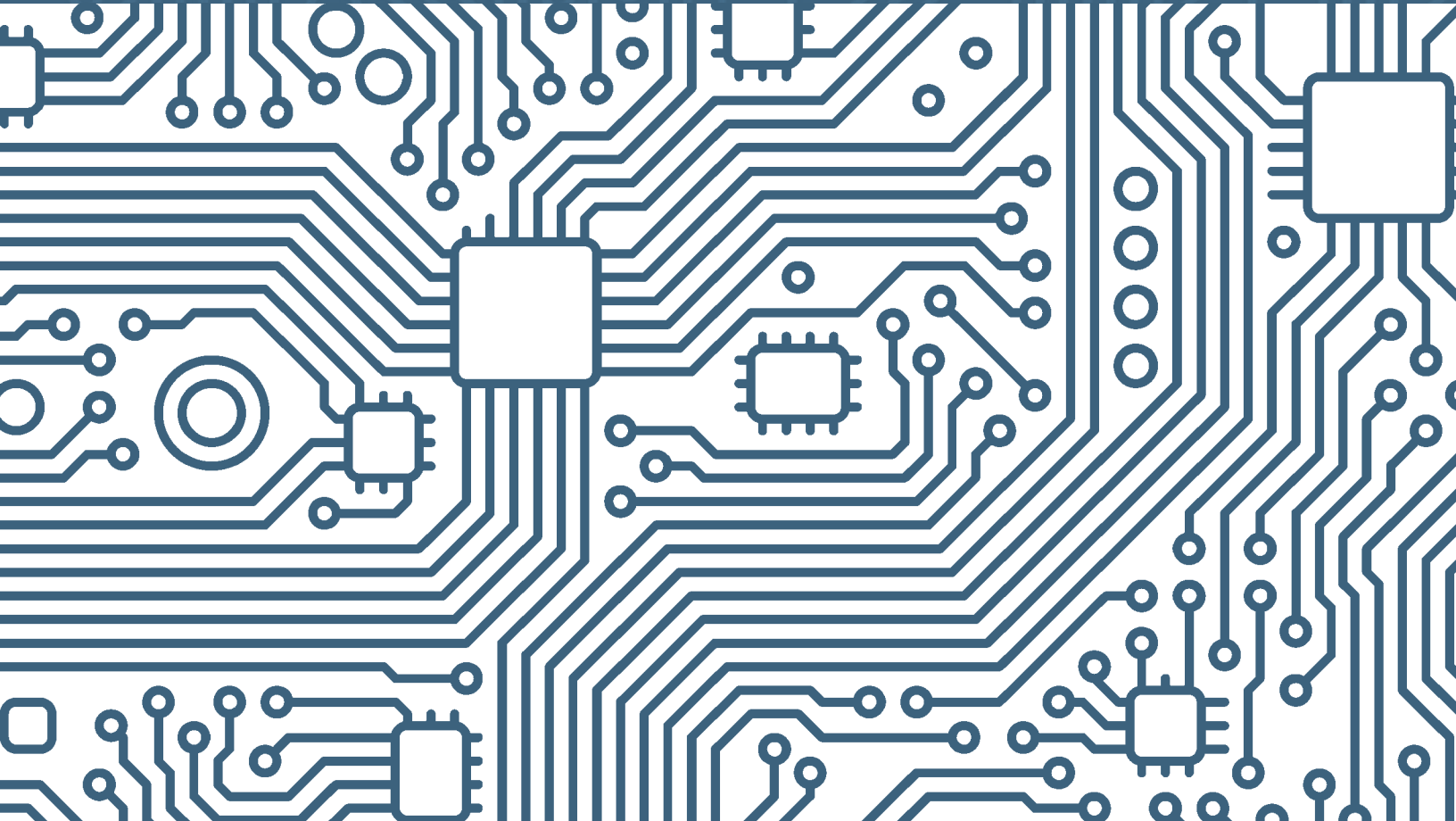
Comprehensive



Deborah Morley
Charles S. Parker

15th Edition

UNDERSTANDING COMPUTERS: TODAY AND TOMORROW



COMPREHENSIVE

DEBORAH MORLEY
CHARLES S. PARKER



Australia • Brazil • Japan • Korea • Mexico • Singapore • Spain • United Kingdom • United States

This is an electronic version of the print textbook. Due to electronic rights restrictions, some third party content may be suppressed. Editorial review has deemed that any suppressed content does not materially affect the overall learning experience. The publisher reserves the right to remove content from this title at any time if subsequent rights restrictions require it. For valuable information on pricing, previous editions, changes to current editions, and alternate formats, please visit www.cengage.com/highered to search by ISBN#, author, title, or keyword for materials in your areas of interest.

**Understanding Computers: Today and Tomorrow,
15th Edition**

Deborah Morley and Charles S. Parker

Vice President, General Manager: Dawn Gerrain

Product Director: Kathleen McMahon

Product Team Manager: Donna Gridley

Director, Development: Marah Bellegarde

Product Development Manager: Leigh Hefferon

Senior Content Developer:

Michelle Ruelos Cannistraci

Developmental Editor: Pam Conrad

Product Assistant: Melissa Stehler

Marketing Manager: Gretchen Swann, Kristie Clark

Production Director: Patty Stephan

Content Project Manager: Jennifer Feltri-George

Manufacturing Planner: Fola Orekoya

Rights Acquisition Specialist: Christine Myaskovsky

Production Service: Integra Software Services Pvt. Ltd.

Cover Designer: GEX Publishing Services

Cover Image: ©Olivier Le Moal/Shutterstock

© 2015, 2013 Cengage Learning

WCN: 02-200-203

ALL RIGHTS RESERVED. No part of this work covered by the copyright herein may be reproduced, transmitted, stored, or used in any form or by any means graphic, electronic, or mechanical, including but not limited to photocopying, recording, scanning, digitizing, taping, Web distribution, information networks, or information storage and retrieval systems, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without the prior written permission of the publisher.

For product information and technology assistance, contact us at
Cengage Learning Customer & Sales Support, 1-800-354-9706

For permission to use material from this text or product, submit all
requests online at www.cengage.com/permissions.

Further permissions questions can be e-mailed to
permissionrequest@cengage.com

Library of Congress Control Number: 2013952741

ISBN-13: 978-1-285-76727-7

Cengage Learning200 First Stamford Place, 4th Floor

Stamford, CT 06902

USA

Cengage Learning is a leading provider of customized learning solutions with office locations around the globe, including Singapore, the United Kingdom, Australia, Mexico, Brazil, and Japan. Locate your local office at:

www.cengage.com/global

Cengage Learning products are represented in Canada by Nelson Education, Ltd.

To learn more about Cengage Learning, visit www.cengage.com

Purchase any of our products at your local college store or at our preferred online store www.cengagebrain.com

Notice to the Reader

Publisher does not warrant or guarantee any of the products described herein or perform any independent analysis in connection with any of the product information contained herein. Publisher does not assume, and expressly disclaims, any obligation to obtain and include information other than that provided to it by the manufacturer. The reader is expressly warned to consider and adopt all safety precautions that might be indicated by the activities described herein and to avoid all potential hazards. By following the instructions contained herein, the reader willingly assumes all risks in connection with such instructions. The publisher makes no representations or warranties of any kind, including but not limited to, the warranties of fitness for particular purpose or merchantability, nor are any such representations implied with respect to the material set forth herein, and the publisher takes no responsibility with respect to such material. The publisher shall not be liable for any special, consequential, or exemplary damages resulting, in whole or part, from the readers' use of, or reliance upon, this material.

PREFACE

In today's technology-oriented society, computers and technology impact virtually everyone's life. *Understanding Computers: Today and Tomorrow, 15th Edition* is designed to ensure that students are current and informed in order to thrive in our technology-oriented, global society. With this new edition, students not only learn about relevant cutting-edge technology trends, but they also gain a better understanding of technology in general and the important issues surrounding technology today. This information gives students the knowledge they need to succeed in today's world.

This nontechnical, introductory text explains in straightforward terms the importance of learning about computers and other computing devices, the various types of devices and their components, the principles by which computers work, the practical applications of computers and related technologies, the ways in which the world is being changed by these technologies, and the associated risks and other potential implications of computers and related technologies. The goal of this text is to provide readers with a solid knowledge of computing fundamentals, an understanding of the impact of our technology-oriented society, and a framework for using this knowledge effectively in their lives.

KEY FEATURES

Just like its previous editions, *Understanding Computers: Today and Tomorrow, 15th Edition* provides current and comprehensive coverage of important topics. Flexible organization and an engaging presentation, combined with a variety of learning tools associated with each chapter, help students master the important computing concepts they will encounter in school, on the job, and in their personal lives.

Currency and Accuracy

The state-of-the-art content of this book reflects the latest technologies, trends, and classroom needs. To reflect the importance of mobile computing today, the entire text has an increased emphasis on smartphones, media tablets, mobile apps, and the issues that surround them, such as mobile security. All topics and figures have been updated for currency and, to ensure the content is as accurate and up to date as possible, numerous **Industry Expert Reviewers** provided feedback and suggestions for improvements to the content in their areas of expertise. Throughout the writing and production stages, enhancements were continually made to ensure that the final product is as current and accurate as possible.

Comprehensiveness and Depth

Accommodating a wide range of teaching styles, *Understanding Computers: Today and Tomorrow, 15th Edition* provides comprehensive coverage of traditional topics while also covering relevant, up-to-the-minute new technologies and important societal issues. This edition has an increased emphasis on mobile computing, cloud applications, and social media and includes the following new topics:

- ▶ New hardware developments, including smartphones, media tablets, smart watches, Google Glass, hybrid notebook-tablet computers, tiny PCs like the Raspberry Pi and Chromecast, GPUs, immersion cooling systems, tablet and smartphone docks,

personal 3D printers, projector phones, self-driving cars, self-healing devices, perceptual computing, gesture input, touch mice, eye tracking tablets, tablet storage devices, DNA storage, 4K (Ultra HD) Blu-ray Discs, and digital ecosystems.

- New software developments and issues, including Windows 8, iOS 7 and other new mobile operating systems, Office 2013/365, digital badges, the Google Play store, sending documents to the cloud, and the impact of big data and cloud computing.
- New mobile applications, including Bring Your Own Device (BYOD), mobile ticketing, mobile data caps, group messaging, geofencing, NFC and other device-based digital wallets, mobile payment processing, Google Now, and mobile ergonomics.
- New networking technologies, including new and emerging Wi-Fi standards, the Internet of Things (IoT), Bluetooth Smart, software defined networking (SDN), and new Wi-Fi-enabled products such as smart thermostats, scales, and Wi-Fi locks.
- New security risks, including BYOD security issues, social media hacks, and scareware, ransomware, and chware.
- New security precautions, including digital tattoos and other emerging biometric systems, soft and hard tokens for OTPs/two-factor authentication, 3D Secure online purchase verification, wireless tethers for mobile devices, and proximity devices and apps to automatically lock and unlock a computer.
- New Web applications, such as cloud printing, Internet monitors, virtual currency, military virtual worlds, social commerce, social media integration, and cloud-based digital wallets.
- New software and Web development tools, such as HTML5, push content and xRTML, Web analytics, social media analytics, user interface (UI) builders, wireframes, integrated development environments (IDEs), Dart, IFTTT Web services, and the Android SDK and Eclipse IDE for creating Android apps.

Readability

We remember more about a subject if it is made interesting and exciting, as well as presented in a straightforward manner. This book is written in a conversational, down-to-earth style—one designed to be accurate without being intimidating. Concepts are explained clearly and simply, without the use of overly technical terminology. More complex concepts are explained in an understandable manner and with realistic examples from everyday life.

Chapter Learning Tools

1. **Outline, Learning Objectives, and Overview:** For each chapter, an **Outline** of the major topics covered, a list of student **Learning Objectives**, and a **Chapter Overview** help instructors put the subject matter of the chapter in perspective and let students know what they will be reading about.
2. **Boldfaced Key Terms and Running Glossary:** Important terms appear in boldface type as they are introduced in the chapter. These terms are defined at the bottom of the page on which they appear and in the end-of-text glossary.
3. **Chapter Boxes:** In each chapter, a **Trend** box provides students with a look at current and upcoming technology trends; an **Inside the Industry** box provides insight into some of the practices and issues related to the computer industry; a **How It Works** box explains in detail how a technology or product works; and a **Technology and You** box takes a look at how computers and technology are used in everyday life.
4. **Ask the Expert Boxes:** In each chapter, three **Ask the Expert** boxes feature a question about a computing concept, a trend, or how computers

CHAPTER 4 INPUT AND OUTPUT 183

TREND

Perceptual Computing

First connects to a computer via a USB port and creates an application that 3D interactive sense made which users can make goals push later again to the phone, and more objects around as they use using a touch screen. Second that they can be directly touching the screen. And incorporated system such as this have additional advantages such as being able to use the gesture instead of just a gesture, avoiding the buttons and given issues related to public keyboard and touch screens are allowing for a full touch and enabling them to be performed from a safe distance such as from a nearby chair or through a glass window (see below).



can later contracts to the computer, be used as an image, be used as handwriting, characters that can be recognized by the computer, or be converted to a digital, typed text. For the latest two options, visit www.handwritingrecognition.com for more info.


402 SYSTEMS

ASK THE EXPERT

Robot Paolo Pignatari, CTO, Robot

How will robots impact our daily lives in the next few years?

Robotics is one of the most promising areas for scientific innovation and economic growth in America. Decreasing costs, technological advancement, and increasing adoption mean the robots of the future will help us accomplish our every greater variety of tasks in the home, in the field, in hospitals, in the workplace, and beyond. In order to deliver on the promise of robots, it is very important that the industry remain focused on building practical solutions—robots that solve real-world problems and provide value. Looking ahead, robots also have tremendous potential for enhancing the independence of a growing older population, allowing people to stay in their homes longer and have increased access to care.



(DARPA) involves with its variable history and many capabilities to give an individual additional physical capabilities and precision. For instance, an exoskeleton can carry a soldier the ability to carry heavy loads and carry heavy loads that are not used without the suit—up to 200 pounds at a top speed of 10 mph for the Human Exoskeleton Load Carrying (HELIX) exoskeleton suit shown in Figure 12-17. Exoskeletons also allow the user to use their additional capabilities, such as being made of lightweight material that is able to be folded or collapsed to form a shield or new form a modified use of a soldier's health. Other possible features of an exoskeleton will include changing its color automatically for camouflage purposes, reducing information via sensors about a soldier's health status, and locating in field navigators and administering positions on a specific process in a world where directed by a physical (DARPA) is also involved with the development of robot-producible arms that feel, look, and perform like natural arms—these robotic arms will be fully intelligently processed that are reported in the line of data.

Business and Industrial Robots

Robots are used in the home for a number of purposes, such as for looking for missing items, for cleaning, and for other tasks, as well as working on factory assembly lines and other manufacturing tasks. They are also used in agriculture, such as for planting and harvesting crops. Robots are also used for services in collapsed areas and buildings, and other dangerous tasks. They are also used to facilitate videoconferencing and other remote presence applications. They are also used for a remote presence and follow tasks and other things to and from the participant. For instance, the remote presence robot shown in Figure 12-18 is a




NEW and Updated Expert Insight Features

In the exciting **Expert Insight** feature located at the end of each module, industry experts provide students with personal insights on topics presented in the book, including their personal experiences with technology, key points to remember, and advice for students. The experts, professionals from these major companies—**D-Link, Logitech, Microsoft, McAfee, eBay, ACM/Google, and Dell**—provide a unique perspective on the module content and how the topics discussed in the module impact their lives and their industry, what it means for the future, and more!

Student and Instructor Support Materials

Understanding Computers: Today and Tomorrow, 15th Edition

is available with a complete package of support materials

for instructors and students. Included in the package are **CourseMate**, the **Instructor Companion Site**, and, if access to SAM has been purchased, **SAM Computer Concepts** material is available.

CourseMate

The *Understanding Computers, 15th Edition* includes **CourseMate**, which helps you make the grade. CourseMate includes:

- **Key Term Matching and Flashcards**—allow students to test their knowledge of selected chapter key terms.
- **Interactive Quiz**—allows students to test their retention of chapter concepts.
- **Global Technology Watch**—provides additional reading on the latest technology topics.
- **Beat the Clock**—allows students to test how ready they are for upcoming exams.
- **Crossword Puzzles**—incorporate the key terms from each chapter into an online interactive crossword puzzle
- **Online Videos**—include several videos per chapter related to the topics in that chapter, as well as practical “How To” information related to chapter topics.
- **Further Exploration**—includes links to additional information about content covered in each chapter.
- **Interactive eBook**—includes highlighting, note taking, and search capabilities.
- **Engagement Tracker**—monitors student engagement in the course.
- **Additional Resources**—include additional resources that can be viewed or printed, such as **Expert Insights**; an **Online Study Guide**, **Online Summary**, and **Online Glossary** for each chapter; a **Guide to Buying a PC** and a **Computer History Timeline**; and more information about **Numbering Systems** and **Coding Charts**.

(Go to cengagebrain.com to access these resources.)

Instructor Companion Site

Everything you need for your course in one place! This collection of book-specific lecture and class tools is available online via www.cengage.com/login. Access and download PowerPoint presentations, images, Instructor’s Manual, videos, and more.

Electronic Instructor’s Manual

The **Instructor’s Manual** is written to provide instructors with practical suggestions for enhancing classroom presentations. The Instructor’s Manual provides: **Lecture Notes**, **Teacher Tips**, **Quick Quizzes**, **Classroom Activities**, **Discussion Questions**, **Key Terms**, a **Chapter Quiz**, and more!

Cengage Learning Testing Powered by Cognero

Cengage Learning Testing Powered by Cognero is a flexible, online system that allows you to:

- Author, edit, and manage test bank content from multiple Cengage Learning solutions
- Create multiple test versions in an instant
- Deliver tests from your LMS, your classroom, or wherever you want

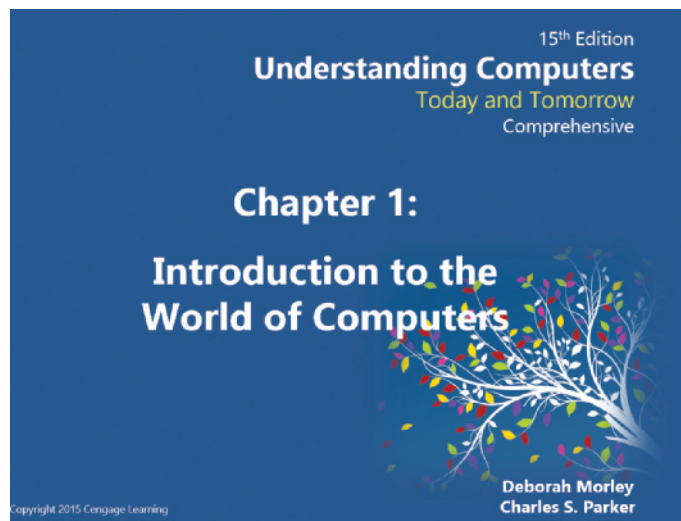
PowerPoint Presentations

This book has **Microsoft PowerPoint presentations** available for each chapter. These are included as a teaching aid for classroom presentation, to make available to students on a network for chapter review, or to be printed for classroom distribution. Instructors can customize these presentations to cover any additional topics they introduce to the class. **Figure Files** for all figures in the textbook are also available online.

SAM: Skills Assessment Manager

SAM 2013 is designed to help bring students from the classroom to the real world. It allows students to train and test on important computer skills in an active, hands-on environment. SAM’s easy-to-use system includes powerful interactive exams, training, and projects on the most commonly used Microsoft Office applications. SAM simulates the Office 2013 application environment, allowing students to demonstrate their knowledge and think through the skills by performing real-world tasks such as bolding text or setting up slide transitions. Add in live-in-the-application projects and students are on their way to truly learning and applying skills to business-centric documents.

Designed to be used with the New Perspectives Series, SAM includes handy page references, so students can print helpful study guides that match the New Perspectives Series textbooks used in class. For instructors, SAM also includes robust scheduling and reporting features.



ACKNOWLEDGMENTS

We would like to extend a special thank you to all of the industry professionals who provided their expertise for the **Expert Insight** features:

Introduction Module: Daniel Kelley, Vice President, Marketing, D-Link Systems, Inc.

Hardware Module: Ali Moayer, Senior Director of Engineering, Logitech

Software Module: Stephen Rose, Senior Product Marketing and Community Manager, Windows Commercial, Microsoft

Networks and the Internet Module: Greg Hampton, Vice President, Product Management, McAfee

Business on the Web Module: Jim Griffith, Dean of eBay Education, eBay

Systems Module: Stuart Feldman, Past President of ACM and Vice President, Engineering, Google

Computers and Society Module: Frank Molsberry, Sr. Principal Engineer and Security Technologist, Dell Inc.

In addition, we are very grateful to the numerous Industry Expert Reviewers that perform technical reviews and provide helpful suggestions each edition to ensure this book is as accurate and current as possible. We would also like to thank the Educational Reviewers who have helped to define and improve the quality of this text over the years. In particular, we would like to thank the following individuals:

Industry Expert Reviewers

Julie Anne Mossler, Director of Communications, Groupon; Alan Tringham, Senior Marketing Communications Manager, ARM; The Wi-Fi Alliance; Mike Hall, Corporate Communications, Seagate Technology; Kevin Curtis, CTO, InPhase Technologies; Sriram K. Peruvemba, Vice President, Marketing, E Ink Corporation; Jim Sherhart, Senior Director of Marketing, Data Robotics; Jack Dollard, Marketing, Mitek Systems; Joe Melfi, Director of Product Marketing for Cloud Solutions, D-Link Systems; Dave Gelvin, President, Tranzeo Wireless USA; Kevin Raineri, Director, Sales and Marketing, Innovative Card Technologies; Bill Shribman, Executive Producer, WGBH Interactive; Mike Markham, Vice President of Sales, Cadre Technologies; Renee Cassata, Marketing Manager, iDashboards; Russell T. Cross, Vice President of AAC Products, Prentke Romich Company; Dr. Kimberly Young, Director, The Center for Internet Addiction Recovery; Jason Taylor, Worldwide Director of Corporate Communications, MobiTV; Nicole Rodrigues, Public Relations Manager, MobiTV; Stephen Yeo, Worldwide Strategic Marketing Director, IGEL Technology; Bob Hirschfeld, Public Information Officer, Lawrence Livermore National Lab; Bryan Crum, Vice President of Communication, Omnilert, LLC; David Bondurant, MRAM Product Manager, Freescale Semiconductor, Inc.; Rick McGowan, Vice President & Senior Software Engineer, Unicode, Inc.; Margaret Lewis, Director of Commercial Solutions, AMD; Mark Tekunoff, Senior Technology Manager, Kingston Technology; Billy Rudock, Customer Service Staff Engineer, Seagate Technology; James M. DePuydt, Ph.D., Technology Director, Imation Corporation; Dan Bloom, Sr. PR Manager, SanDisk; Kevin Curtis, CTO, InPhase Technologies; Gail Levy, Director of Marketing, TabletKiosk; Novell Marketing; John McCreesh, Marketing Project Lead, OpenOffice.org; Jackson Dunlap, ESP Systems; Laura Abram, Director of Corporate Marketing, Dust Networks; Kevin Schader, Communications Director, ZigBee Alliance; Mauro Dresti, Linksys Product Marketing Manager; Lianne Caetano, Executive Director, WirelessHD, LLC; Brad Booth; Howard Frazier; Bob Grow; Michael McCormack; George Cravens, Technical Marketing, D-Link Systems; Christiaan Stoudt, Founder, HomeNetworkHelp.Info; Douglas M. Winneg, President, Software Secure, Inc.; Frank Archambeault, Director of Network Services, Dartmouth College; Adam Goldstein, IT Security Engineer, Dartmouth College; Ellen Young, Manager of Consulting Services, Dartmouth College; Becky Waring, Executive Editor, JiWire.com; Ellen Craw, General Manager, Ilium Software; Michael Behr, Senior Architect, TIBCO; Joe McGlynn, Director of Product Management, CodeGear; John Nash, Vice President of Marketing, Visible Systems; Josh Shaul, Director of Technology Strategy, Application Security, Inc.; Jodi Florence, Marketing Director, IDology, Inc.; Dr. Maressa Hecht Orzack, Director, Computer Addiction Services; Janice K. Mahon, Vice President of Technology Commercialization, Universal Display Corporation; Dr. Nhon Quach, Next Generation Processor Architect, AMD; Jos van Haaren, Department Head Storage Physics, Philips Research Laboratories; Terry O'Kelly, Technical Communications Manager, Memorex; Randy Culpepper, Texas Instruments RFID Systems; Aaron Newman, CTO and Co-Founder, Application Security Inc.; Alan Charlesworth, Staff Engineer, Sun Microsystems; Khaled A. Elamrawi, Senior Marketing Engineer, Intel Corporation; Timothy D. O'Brien, Senior Systems Engineer, Fujitsu Software; John Paulson, Manager, Product Communications, Seagate Technology; Omid Rahmat, Editor in Chief, Tom's Hardware Guide; Jeremy Bates, Multimedia Developer, R & L Multimedia Developers; Charles Hayes, Product Marketing Manager, SimpleTech, Inc.; Rick McGowan, Vice President & Senior Software Engineer, Unicode, Inc.; Russell Reynolds, Chief Operating Officer & Web Designer, R & L Multimedia Developers; Rob Stephens, Director, Technology Strategies, SAS; Dave Stow, Database Specialist, OSE Systems, Inc.

Educational Reviewers

Marc Forestiere, Fresno City College; Beverly Amer, Northern Arizona University; James Ambrose Jr., Southern University, Louisiana; Virginia Anderson, University of North Dakota; Robert Andree, Indiana University Northwest; Linda Armbruster, Rancho Santiago College; Michael Atherton, Mankato State University; Gary E. Baker, Marshalltown Community College; Richard Batt, Saint Louis Community College at Meramec; Luverne Bierle, Iowa Central Community College; Fariba Bolandhemat, Santa Monica College; Jerry Booher, Scottsdale Community College; Frederick W. Bounds, Georgia Perimeter College; James Bradley, University of Calgary; Curtis Bring, Moorhead State University; Brenda K. Britt, Fayetteville Technical Community College; Cathy Brotherton, Riverside Community College; Chris Brown, Bemidji State University; Janice Burke, South Suburban College; James Buxton, Tidewater Community College, Virginia; Gena Casas, Florida Community College, Jacksonville; Thomas Case, Georgia Southern University; John E. Castek, University of Wisconsin-La Crosse; Mario E. Cecchetti, Westmoreland County Community College; Jack W. Chandler, San Joaquin Delta College; Alan Charlesworth, Staff Engineer, Sun Microsystems; Jerry M. Chin, Southwest Missouri State University;

Edward W. Christensen, Monmouth University; Carl Clavadetscher, California State Polytechnic University; Vernon Clodfelter, Rowan Technical College, North Carolina; Joann C. Cook, College of DuPage; Laura Cooper, College of the Mainland, Texas; Cynthia Corritore, University of Nebraska at Omaha; Sandra Cunningham, Ranger College; Marvin Daugherty, Indiana Vocational Technical College; Donald L. Davis, University of Mississippi; Garrace De Groot, University of Wyoming; Jackie Dennis, Prairie State College; Donald Dershem, Mountain View College; John DiElsi, Marcy College, New York; Mark Dishaw, Boston University; Eugene T. Dolan, University of the District of Columbia; Bennie Allen Dooley, Pasadena City College; Robert H. Dependahl Jr., Santa Barbara City College; William Dorin, Indiana University Northwest; Mike Doroshov, Eastfield College; Jackie O. Duncan, Hopkinsville Community College; John Dunn, Palo Alto College; John W. Durham, Fort Hays State University; Hyun B. Eom, Middle Tennessee State University; Michael Feiler, Merritt College; Terry Felke, WR Harper College; J. Patrick Fenton, West Valley Community College; James H. Finger, University of South Carolina at Columbia; William C. Fink, Lewis and Clark Community College, Illinois; Ronald W. Fordonski, College of Du Page; Connie Morris Fox, West Virginia Institute of Technology; Paula S. Funkhouser, Truckee Meadows Community College; Janos T. Fustos, Metropolitan State; Gene Garza, University of Montevallo; Timothy Gottleber, North Lake College; Dwight Graham, Prairie State College; Wade Graves, Grayson County College; Kay H. Gray, Jacksonville State University; David W. Green, Nashville State Technical Institute, Tennessee; George P. Grill, University of North Carolina, Greensboro; John Groh, San Joaquin Delta College; Rosemary C. Gross, Creighton University; Dennis Guster, Saint Louis Community College at Meramec; Joe Hagarty, Raritan Valley Community College; Donald Hall, Manatee Community College; Jim Hanson, Austin Community College; Sallyann Z. Hanson, Mercer County Community College; L. D. Harber, Volunteer State Community College, Tennessee; Hank Hartman, Iowa State University; Richard Hatch, San Diego State University; Mary Lou Hawkins, Del Mar College; Ricci L. Heishman, Northern Virginia Community College; William Hightower, Elon College, North Carolina; Sharon A. Hill, Prince George's Community College, Maryland; Alyse Hollingsworth, Brevard College; Fred C. Homeyer, Angelo State University; Stanley P. Honacki, Moraine Valley Community College; L. Wayne Horn, Pensacola Junior College; J. William Howorth, Seneca College, Ontario, Canada; Mark W. Huber, East Carolina University; Peter L. Irwin, Richland College, Texas; John Jasma, Palo Alto College; Elizabeth Swoope Johnson, Louisiana State University; Jim Johnson, Valencia Community College; Mary T. Johnson, Mt. San Antonio College; Susan M. Jones, Southwest State University; Amardeep K. Kahlon, Austin Community College; Robert T. Keim, Arizona State University; Mary Louise Kelly, Palm Beach Community College; William R. Kenney, San Diego Mesa College; Richard Kerns, East Carolina University, North Carolina; Glenn Kersnick, Sinclair Community College, Ohio; Richard Kiger, Dallas Baptist University; Gordon C. Kimbell, Everett Community College, Washington; Robert Kirklin, Los Angeles Harbor Community College; Judith A. Knapp, Indiana University Northwest; Mary Veronica Kolesar, Utah State University; James G. Kriz, Cuyahoga Community College, Ohio; Joan Krone, Denison University; Fran Kubicek, Kalamazoo Valley Community College; Rose M. Laird, Northern Virginia Community College; Robert Landrum, Jones Junior College; Shelly Langman, Bellevue Community College; James F. LaSalle, The University of Arizona; Chang-Yang Lin, Eastern Kentucky University; Linda J. Lindaman, Black Hawk College; Alden Lorents, Northern Arizona University; Paul M. Lou, Diablo Valley College; Deborah R. Ludford, Glendale Community College; Kent Lundin, Brigham Young University-Idaho; Barbara J. Maccarone, North Shore Community College; Wayne Madison, Clemson University, South Carolina; Donna L. Madsen, Kirkwood Community College; Randy Marak, Hill College; Gary Marks, Austin Community College, Texas; Kathryn A. Marold, Ph.D., Metropolitan State College of Denver; Cesar Marron, University of Wyoming; Ed Martin, Kingsborough Community College; Vickie McCullough, Palomar College; James W. McGuffee, Austin Community College; James McMahon, Community College of Rhode Island; William A. McMillan, Madonna University; Don B. Medley, California State Polytechnic University; John Melrose, University of Wisconsin—Eau Claire; Dixie Mercer, Kirkwood Community College; Mary Meredith, University of Southwestern Louisiana; Marilyn Meyer, Fresno City College; Carolyn H. Monroe, Baylor University; William J. Moon, Palm Beach Community College; Marilyn Moore, Purdue University; Marty Murray, Portland Community College; Don Nielsen, Golden West College; George Novotny, Ferris State University; Richard Okezie, Mesa Community College; Joseph D. Oldham, University of Kentucky; Dennis J. Olsen, Pikes Peak Community College; Bob Palank, Florissant Community College; James Payne, Kellogg Community College; Lisa B. Perez, San Joaquin Delta College; Savitha Pinnepalli, Louisiana State University; Delores Pusins, Hillsborough CC; Mike Rabaut, Hillsborough CC; Robert Ralph, Fayetteville Technical Institute, North Carolina; Herbert F. Rebhun, University of Houston-Downtown; Nicholas John Robak, Saint Joseph's University; Arthur E. Rowland, Shasta College; Kenneth R. Ruhrop, St. Petersburg Junior College; John F. Sanford, Philadelphia College of Textiles and Science; Kammy Sanghera, George Mason University; Carol A. Schwab, Webster University; Larry Schwartzman, Trident Technical College; Benito R. Serenil, South Seattle Community College; Allanagh Sewell, Southeastern Louisiana University; Tom Seymour, Minot State University; John J. Shuler, San Antonio College, Texas; Gayla Jo Slauson, Mesa State College; Harold Smith, Brigham Young University; Willard A. Smith, Tennessee State University; David Spaisman, Katherine Gibbs; Elizabeth Spooner, Holmes Community College; Timothy M. Stanford, City University; Alfred C. St. Onge, Springfield

Technical Community College, Massachusetts; Michael L. Stratford, Charles County Community College, Maryland; Karen Studniarz, Kishwaukee College; Sandra Swanson, Lewis & Clark Community College; Tim Sylvester, Glendale Community College; Semih Tahaoglu, Southeastern Louisiana University; Jane J. Thompson, Solano Community College; Sue Traynor, Clarion University of Pennsylvania; William H. Trueheart, New Hampshire College; James D. Van Tassel, Mission College; James R. Walters, Pikes Peak Community College; Joyce V. Walton, Seneca College, Ontario, Canada; Diane B. Walz, University of Texas at San Antonio; Joseph Waters, Santa Rosa Junior College, California; Liang Chee Wee, University of Arizona; Merrill Wells, Red Rocks Community College; Fred J. Wilke, Saint Louis Community College; Charles M. Williams, Georgia State University; Roseanne Witkowski, Orange County Community College; David Womack, University of Texas, San Antonio; George Woodbury, College of the Sequoias; Nan Woodsome, Araphoe Community College; James D. Woolever, Cerritos College; Patricia Joann Wykoff, Western Michigan University; A. James Wynne, Virginia Commonwealth University; Robert D. Yearout, University of North Carolina at Asheville; Israel Yost, University of New Hampshire; and Vic Zamora, Mt. San Antonio College.

We would also like to thank the people on the Cengage team—their professionalism, attention to detail, and enormous enthusiasm make working with them a pleasure. In particular, we'd like to thank Donna Gridley, Michelle Ruelos Cannistraci, Jennifer Feltri-George, Christine Myaskovsky, and Pam Conrad for all their ideas, support, and tireless efforts during the design, writing, rewriting, and production of this book. We would also like to thank Marissa Falco for the interior design and GEX Publishing Services for the cover design. We want to thank Sreejith Govindan and Integra for all their help managing the production of the book. Thanks also to Kathleen McMahon.

We are also very appreciative of the numerous individuals and organizations that were kind enough to supply information and photographs for this text and the many organizations, as well as Daniel Davis of Tinkernut.com, that generously allowed us to use their content for the Online Videos, which can be found on CourseMate.

We sincerely hope you find this book interesting, informative, and enjoyable to read.

Deborah Morley
Charles S. Parker

BRIEF CONTENTS

Preface iii

MODULE Introduction 2

Chapter 1

Introduction to the World of Computers 4

Expert Insight on Personal Computers 46

MODULE Hardware 48

Chapter 2

The System Unit: Processing and Memory 50

Chapter 3

Storage 92

Chapter 4

Input and Output 128

Expert Insight on Hardware 172

MODULE Software 174

Chapter 5

System Software: Operating Systems and Utility Programs 176

Chapter 6

Application Software 212

Expert Insight on Software 252

MODULE Networks and the Internet 254

Chapter 7

Computer Networks 256

Chapter 8

The Internet and the World Wide Web 298

Chapter 9

Network and Internet Security 346

Expert Insight on Networks and the Internet 390

MODULE Business on the Web 392

Chapter 10

Multimedia and the Web 394

Chapter 11

E-Commerce 430

Expert Insight on Web-Based Multimedia and E-Commerce 462

MODULE Systems 464

Chapter 12

Information Systems and System

Development 466

Chapter 13

Program Development and Programming

Languages 506

Chapter 14

Databases and Database Management

Systems 548

Expert Insight on Systems 586

MODULE Computers and Society 588

Chapter 15

Computer Security and Privacy 590

Chapter 16

Intellectual Property Rights, Ethics, Health, Access, and the Environment 632

Expert Insight on Computers and Society 678

References and Resources Guide R-1

Glossary/Index I-1

CONTENTS

Preface iii

MODULE Introduction 2

Chapter 1 Introduction to the World of Computers 4

Overview 5

Computers in Your Life 5

- > Why Learn About Computers? 5
- > Computers in the Home 7
- > Computers in Education 7
- > Computers on the Job 8
- > Computers on the Go 9

What Is a Computer and What Does It Do? 10

- > Data vs. Information 11
- > Computers Then and Now 12
- > Hardware 14
- > Software 16
- > Computer Users and Professionals 17

Computers to Fit Every Need 19

- > Embedded Computers 19
- > Mobile Devices 20
- > Personal Computers (PCs) 21
- > Servers 25
- > Mainframe Computers 26
- > Supercomputers 26

Computer Networks and the Internet 27

- > What Are the Internet and the World Wide Web? 27
- > Accessing a Network or the Internet 29
- > Surfing the Web 33
- > Searching the Web 34
- > E-Mail 34

Computers and Society 36

- > Benefits of a Computer-Oriented Society 36

- > Risks of a Computer-Oriented Society 36
- > Differences in Online Communications 38
- > The Anonymity Factor 39
- > Information Integrity 39

Summary 40

Review Activities 42

Projects 44

TECHNOLOGY AND YOU Restaurant iPad Ordering Systems 9

TREND Tiny PCs 20

INSIDE THE INDUSTRY Tech Clothing 22

HOW IT WORKS Campus Emergency Notification Systems 32



Expert Insight on Personal Computers 46

MODULE Hardware 48

Chapter 2 The System Unit: Processing and Memory 50

Overview 51

Data and Program Representation 51

- > Digital Data Representation 51
- > Representing Numerical Data: The Binary Numbering System 52
- > Coding Systems for Text-Based Data 53
- > Coding Systems for Other Types of Data 54
- > Representing Software Programs: Machine Language 56

Inside the System Unit 56

- > The Motherboard 56
- > The Power Supply and Drive Bays 57
- > Processors 58
- > Memory 62
- > Fans, Heat Sinks, and Other Cooling Components 65
- > Expansion Slots, Expansion Cards, and ExpressCard Modules 66
- > Buses 68
- > Ports and Connectors 70

How the CPU Works 73

- > Typical CPU Components 73
- > The System Clock and the Machine Cycle 75

Making Computers Faster and Better Now and in the Future 76

- > Improving the Performance of Your System Today 77
- > Strategies for Making Faster and Better Computers 79
- > Future Trends 81

*Summary 86**Review Activities 88**Projects 90*

> Logical vs. Physical Representation 95

> Type of Storage Technology Used 96

Hard Drives 96

- > Magnetic Hard Drives and Solid-State Drives (SSDs) 96
- > Internal vs. External Hard Drives 102
- > Hard Drive Speed, Disk Caching, and Hybrid Hard Drives 103
- > Hard Drive Partitioning and File Systems 104
- > Hard Drive Interface Standards 105

Optical Discs and Drives 105

- > Optical Disc Characteristics 105
- > Read-Only Optical Discs: CD-ROM, DVD-ROM, and BD-ROM Discs 108
- > Recordable Optical Discs: CD-R, DVD-R, DVD+R, and BD-R Discs 108
- > Rewritable Optical Discs: CD-RW, DVD-RW, DVD+RW, and BD-RE Discs 109

Flash Memory Storage Systems 110

- > Embedded Flash Memory 110
- > Flash Memory Cards and Readers 111
- > USB Flash Drives 112

Other Types of Storage Systems 114

- > Network and Cloud Storage Systems 114
- > Smart Cards 116
- > Holographic Storage 117
- > Storage Systems for Large Computer Systems 118

Evaluating Your Storage Alternatives 121*Summary 122**Review Activities 124**Projects 126*

HOW IT WORKS GPUs and Transformers: The Ride 3D at Universal Studios 60

TREND Tablet Docks 72

INSIDE THE INDUSTRY Moore's Law 74

TECHNOLOGY AND YOU "Magic" Glass 82

Chapter 3 Storage 92

Overview 93

Storage Systems Characteristics 93

- > Storage Media and Storage Devices 93
- > Volatility 94
- > Random vs. Sequential Access 94

HOW IT WORKS More Storage for Your Tablet 98

INSIDE THE INDUSTRY Data Recovery Experts 101

TREND DNA Data Storage 110

TECHNOLOGY AND YOU Thumb Drive PCs 113

Chapter 4 Input and Output 128

Overview 129

Keyboards 129

Pointing and Touch Devices 131

- > Mice 131
- > Pens/Styluses 132
- > Touch Screens 135
- > Other Pointing Devices 136

Scanners, Readers, and Digital

Cameras 138

- > Scanners 139
- > Readers 140
- > Digital Cameras 146

Audio Input 148

- > Voice Input and Speech Recognition Systems 148
- > Music Input Systems 150

Display Devices 150

- > Display Device Characteristics 150
- > Flat-Panel Display Technologies 155
- > Data and Multimedia Projectors 158

Printers 159

- > Printer Characteristics 159
- > Laser Printers 161
- > Ink-Jet Printers 162
- > Special-Purpose Printers 163

Audio Output 165

Summary 166*Review Activities* 168*Projects* 170**TREND** Perceptual Computing 133**HOW IT WORKS** Augmented Reality 138**TECHNOLOGY AND YOU** Mobile Deposits 145**INSIDE THE INDUSTRY** E-Paper 156**Expert Insight on
Hardware 172****MODULE Software** 174**Chapter 5** System Software: Operating Systems and Utility Programs 176

Overview 177

System Software vs. Application Software 177

The Operating System 178

- > Functions of an Operating System 178
- > Processing Techniques for Increased Efficiency 182
- > Differences Among Operating Systems 185

Operating Systems for Personal Computers and Servers 188

- > DOS 188
- > Windows 188
- > Mac OS 192
- > UNIX 193
- > Linux 193
- > Chrome OS 194

Operating Systems for Mobile Devices 194

- > Windows Phone 8, Windows RT, and Windows Embedded 196
- > Android 196
- > iOS 197
- > BlackBerry OS and BlackBerry PlayBook OS 197
- > Mobile Linux 197

Operating Systems for Larger Computers 198

Utility Programs 198

- > File Management Programs 198
- > Search Tools 201
- > Diagnostic and Disk Management Programs 201
- > Uninstall and Cleanup Utilities 201
- > File Compression Programs 203
- > Backup and Recovery Utilities 204
- > Antivirus, Antispyware, Firewalls, and Other Security Programs 205

The Future of Operating Systems 205
Summary 206
Review Activities 208
Projects 210

TREND Internet Monitors 187
TECHNOLOGY AND YOU Smart Cars 195
INSIDE THE INDUSTRY Weather Forecasting in the Alps 199
HOW IT WORKS Sending to the Cloud 202

Chapter 6 Application Software 212

Overview 213

The Basics of Application Software 213

- > Software Ownership Rights 213
- > Desktop vs. Mobile Software 217
- > Installed vs. Cloud Software 217
- > Software Suites 221
- > Common Software Commands 222

Word Processing Concepts 225

- > What Is Word Processing? 225
- > Creating a Word Processing Document 227
- > Tables, Graphics, and Templates 229
- > Word Processing and the Web 229

Spreadsheet Concepts 230

- > What Is a Spreadsheet? 230
- > Creating a Spreadsheet 230
- > Charts and What-If Analysis 233
- > Spreadsheets and the Web 233

Database Concepts 234

- > What Is a Database? 234
- > Creating a Database 235
- > Queries and Reports 236
- > Databases and the Web 237

Presentation Graphics Concepts 237

- > What Is a Presentation Graphic? 237
- > Creating a Presentation 238

> Finishing a Presentation 239

> Presentation Graphics and the Web 239

Graphics and Multimedia Concepts 240

- > Graphics Software 240
- > Audio Capture and Editing Software 241
- > Video Editing and DVD Authoring Software 242
- > Media Players 243
- > Graphics, Multimedia, and the Web 243

Other Types of Application Software 243

- > Desktop and Personal Publishing Software 243
- > Educational, Entertainment, and Reference Software 244
- > Note Taking Software and Web Notebooks 244
- > CAD and Other Types of Design Software 244
- > Accounting and Personal Finance Software 245
- > Project Management, Collaboration, and Remote Access Software 245

Summary 246

Review Activities 248

Projects 250

INSIDE THE INDUSTRY Open Source Software 215

TECHNOLOGY AND YOU Mobile Ticketing 218

TREND Airline Apps 220

HOW IT WORKS Gesture Input with Microsoft Office 226



**Expert Insight
 on Software 252**

MODULE Networks and the Internet 254

Chapter 7 Computer Networks 256

Overview 257

What Is a Network? 257

Networking Applications 258

- > The Internet 258
- > Telephone Service 259
- > Television and Radio Broadcasting 260
- > Global Positioning System (GPS) Applications 260
- > Monitoring Systems 261
- > Multimedia Networking 262
- > Videoconferencing, Collaborative Computing, and Telecommuting 263
- > Telemedicine 264

Network Characteristics 265

- > Wired vs. Wireless Networks 265
- > Network Topologies 266
- > Network Architectures 267
- > Network Size and Coverage Area 268

Data Transmission Characteristics 270

- > Bandwidth 270
- > Analog vs. Digital Signals 271
- > Transmission Type and Timing 271
- > Delivery Method 272

Networking Media 273

- > Wired Networking Media 273
- > Wireless Networking Media 275

Communications Protocols and Networking Standards 278

- > TCP/IP and Other Communications Protocols 278
- > Ethernet (802.3) 279
- > Phonerline, Powerline, G.hn, and Broadband over Powerline (BPL) 280
- > Wi-Fi (802.11) 281
- > WiMAX (802.16) 283
- > Cellular Standards 283
- > Bluetooth, Ultra Wideband (UWB), and Other Short-Range Wireless Standards 284

Networking Hardware 288

- > Network Adapters and Modems 288
- > Switches, Routers, and Other Hardware for Connecting Devices and Networks 289
- > Other Networking Hardware 290

Summary 292

Review Activities 294

Projects 296

INSIDE THE INDUSTRY Wireless Power 258

TREND Stadium Wireless Networks 266

TECHNOLOGY AND YOU Wi-Fi SD Cards 282

HOW IT WORKS Smart Homes 287

Chapter 8 The Internet and the World

Wide Web 298

Overview 299

Evolution of the Internet 299

- > From ARPANET to Internet2 299
- > The Internet Community Today 302
- > Myths About the Internet 304

Getting Set Up to Use the Internet 305

- > Type of Device 305
- > Type of Connection and Internet Access 307
- > Selecting an ISP and Setting Up Your Computer 311

Searching the Internet 312

- > Search Sites 312
- > Search Strategies 314
- > Evaluating Search Results 316
- > Citing Internet Resources 317

Beyond Browsing and E-Mail 317

- > Other Types of Online Communications 317
- > Social Networking/Social Media 321
- > Online Shopping and Investing 323
- > Online Entertainment 325
- > Online News, Reference, and Information 328
- > Online Education and Writing 331

Censorship and Privacy Issues 334

- > Censorship 335
- > Web Browsing Privacy 336
- > E-Mail Privacy 339

Summary 340

Review Activities 342

Projects 344

INSIDE THE INDUSTRY Mobile Data
Caps 306

HOW IT WORKS Geofencing 319

TECHNOLOGY AND YOU High-Tech
Workouts 326

TREND The Internet of Things (IoT) 330

Chapter 9 Network and Internet Security 346

Overview 347

Why Be Concerned About Network
and Internet Security? 347

Unauthorized Access and Unauthorized
Use 348

- > Hacking 348
- > War Driving and Wi-Fi Piggybacking 350
- > Interception of Communications 351

Protecting Against Unauthorized Access
and Unauthorized Use 351

- > Access Control Systems 351
- > Firewalls, Encryption, and Virtual Private
Networks (VPNs) 356
- > Additional Public Hotspot Precautions 361
- > Sensible Employee Precautions 361

Computer Sabotage 364

- > Botnets 364
- > Computer Viruses and Other Types of
Malware 364
- > Denial of Service (DoS) Attacks 367
- > Data, Program, or Web Site Alteration 368

Protecting Against Computer
Sabotage 369

- > Security Software 369
- > Other Security Precautions 370

Online Theft, Online Fraud, and Other
Dot Cons 370

- > Theft of Data, Information, and Other
Resources 371
- > Identity Theft, Phishing, Social Media
Hacks, and Pharming 372
- > Online Auction Fraud 376
- > Other Internet Scams 376

Protecting Against Online Theft, Online
Fraud, and Other Dot Cons 377

- > Protecting Against Data and Information
Theft 377
- > Protecting Against Identity Theft,
Phishing, Social Media Hacks, and
Pharming 377
- > Protecting Against Online Auction Fraud
and Other Internet Scams 380

Personal Safety Issues 381

- > Cyberbullying and Cyberstalking 381
- > Online Pornography 382

Protecting Against Cyberbullying,
Cyberstalking, and Other Personal
Safety Concerns 382

- > Safety Tips for Adults 382
- > Safety Tips for Children and Teens 383

Network and Internet Security
Legislation 383

Summary 384

Review Activities 386

Projects 388

HOW IT WORKS Securing a Wireless
Home Router 357

INSIDE THE INDUSTRY Securing
BYOD 362

TREND Beyond Fingerprint Readers—
Digital Tattoos and More 371

TECHNOLOGY AND YOU Online
Financial Alerts 379



**Expert Insight on Networks
and the Internet 390**

MODULE Business on the Web 392

Chapter 10 Multimedia and the Web 394

Overview 395

What Is Web-Based Multimedia? 395

- > Why Learn About Web-Based Multimedia? 395
- > Web-Based Multimedia Applications 396
- > Advantages and Disadvantages of Using Web-Based Multimedia 398

Multimedia Elements 399

- > Text 400
- > Images 400
- > Animation 404
- > Audio 404
- > Video 405

Multimedia Web Site Design 407

- > Basic Design Principles 407
- > Determining the Objectives and Intended Audience of the Site 409
- > Using Flowcharts, Page Layouts, and Storyboards 410
- > Navigational Design Considerations 411
- > Access Considerations 412

Multimedia Web Site Development 414

- > Creating the Multimedia Elements 414
- > Creating the Web Site 414
- > Testing, Publishing, and Maintaining the Site 422

The Future of Web-Based Multimedia 423

Summary 424

Review Activities 426

Projects 428

INSIDE THE INDUSTRY Military Virtual Worlds 399

HOW IT WORKS MP3 Compression 406

TECHNOLOGY AND YOU Responsive Web Design 408

TREND Push Technology and xRTML 420

Chapter 11 E-Commerce 430

Overview 431

What Is E-Commerce? 431

- > Advantages of E-Commerce 432
- > Disadvantages of E-Commerce 435

E-Commerce Business Models 436

- > Business-to-Consumer (B2C) Business Model 437
- > Business-to-Business (B2B) Business Model 437
- > Consumer-to-Consumer (C2C) Business Model 437
- > Business-to-Government (B2G) Business Model 437

Types of E-Commerce Web Sites 438

- > Manufacturer and E-Tailer Sites 438
- > Subscription Sites 438
- > Brokerage Sites 438

Implementing Web-Based E-Commerce 440

- > Step 1: Select Appropriate Business Models and Types of Web Sites 441
- > Step 2: Select the Desired E-Commerce Applications 441
- > Step 3: Develop Procedures for Handling Electronic Financial Transactions 441
- > Step 4: Design and Develop an Effective E-Commerce Web Site 447
- > Step 5: Implement Appropriate Sales and Marketing Strategies 449

Security Issues 455

Summary 456

Review Activities 458

Projects 460

TECHNOLOGY AND YOU Mobile Payments 434

HOW IT WORKS NFC Digital Wallets 446

TREND Social Commerce 450

INSIDE THE INDUSTRY Click Fraud 455



Expert Insight on Web-Based Multimedia and E-Commerce 462

MODULE Systems 464**Chapter 12** Information Systems and System Development 466

Overview 467

What Is an Information System? 467

- > The Need for System Development 468
- > Enterprise Architecture 468
- > Business Intelligence (BI) 469
- > Users of Information Systems 469

Types of Information Systems 471

- > Office and User Productivity Support Systems 471
- > Transaction Processing Systems (TPSs) 472
- > Decision Making Support Systems 473
- > Integrated Enterprise Systems 475
- > Design and Manufacturing Systems 477
- > Artificial Intelligence Systems 478

Responsibility for System Development 484

- > The Information Systems (IS) Department 485
- > Outsourcing 485

The System Development Life Cycle (SDLC) 488

- > Preliminary Investigation 488
- > System Analysis 489
- > System Design 492
- > System Acquisition 493
- > System Implementation 495
- > System Maintenance 497

Approaches to System Development 498

- > The Traditional Approach 498
- > The Iterative Approach 499
- > The End-User Development Approach 499

Summary 500*Review Activities* 502*Projects* 504**HOW IT WORKS** Big Data . . . For Everything 470**INSIDE THE INDUSTRY** The Turing Test and the Loebner Prize 478**TECHNOLOGY AND YOU** Self-Driving Cars 483**TREND** Digital Badges 487**Chapter 13** Program Development and Programming Languages 506

Overview 507

Approaches to Program Design and Development 507

- > Procedural Programming 507
- > Object-Oriented Programming (OOP) 509
- > Aspect-Oriented Programming (AOP) 510
- > Adaptive and Agile Software Development 510

The Program Development Life Cycle (PDLC) 511

- > Problem Analysis 511
- > Program Design 512
- > Program Coding 520
- > Program Debugging and Testing 523
- > Program Implementation and Maintenance 528

Tools for Facilitating Program Development 528

- > Application Lifecycle Management (ALM) Tools 528
- > Application Generators 529
- > Device Development Tools 530
- > Integrated Development Environments (IDEs), Mobile App Builders, and Software Development Kits (SDKs) 530

Programming Languages 532

- > What Is a Programming Language? 532
- > Categories of Programming Languages 532
- > Common Programming Languages 535

Summary 542
 Review Activities 544
 Projects 546

TECHNOLOGY AND YOU Programming Contests 521
INSIDE THE INDUSTRY The Original Program “Bug” 523
TREND Mobile App Builders 531
HOW IT WORKS Creating Apps Using the Android SDK and Eclipse 540

Chapter 14 Databases and Database Management Systems 548

Overview 549

What Is a Database? 549

- > A Simple Relational Database Example 550
- > Individuals Involved with a Database Management System 551
- > The Evolution of Databases 553
- > Advantages and Disadvantages of the DBMS Approach 553

Data Concepts and Characteristics 555

- > Data Hierarchy 555
- > Entities and Entity Relationships 555
- > Data Definition 556
- > The Data Dictionary 557
- > Data Integrity, Security, and Privacy 558
- > Data Organization 562

Database Classifications 564

- > Single-User vs. Multiuser Database Systems 564
- > Client-Server and N-Tier Database Systems 564
- > Centralized vs. Distributed Database Systems 565
- > Disk-Based vs. In-Memory Database Systems 566

Database Models 566

- > The Hierarchical and Network Database Models 566
- > The Relational Database Model 567
- > The Object-Oriented Database Model 574

- > Hybrid Database Models 575
- > Multidimensional Databases 576

Cloud Databases 576

- > Examples of Cloud Databases in Use 576
- > How Cloud Databases Work 578

Summary 580

Review Activities 582

Projects 584

INSIDE THE INDUSTRY File Management Systems 554
HOW IT WORKS Column Databases 563
TREND Law Enforcement Databases 574
TECHNOLOGY AND YOU Cloud Databases 577



**Expert Insight
 on Systems 586**

MODULE Computers and Society 588

Chapter 15 Computer Security and Privacy 590

Overview 591

Why Be Concerned About Computer Security? 591

Hardware Loss, Hardware Damage, and System Failure 591

- > Hardware Loss 592
- > Hardware Damage 592
- > System Failure and Other Disasters 592
- > Protecting Against Hardware Loss, Hardware Damage, and System Failure 593

Software Piracy and Digital Counterfeiting 602

- > Software Piracy 602
- > Digital Counterfeiting 603
- > Protecting Against Software Piracy and Digital Counterfeiting 604

Why Be Concerned About Information Privacy? 606

Databases, Electronic Profiling, Spam, and Other Marketing Activities 607

- > Databases and Electronic Profiling 607
- > Spam and Other Marketing Activities 610
- > Protecting the Privacy of Personal Information 611

Electronic Surveillance and Monitoring 616

- > Computer Monitoring Software 617
- > Video Surveillance 619
- > Employee Monitoring 621
- > Presence Technology 622
- > Protecting Personal and Workplace Privacy 623

Computer Security and Privacy Legislation 624

Summary 626

Review Activities 628

Projects 630

TREND Self-Healing Devices 594
HOW IT WORKS Self-Destructing Devices 596
TECHNOLOGY AND YOU Protecting Your PC 600
INSIDE THE INDUSTRY Data Killers 617

Chapter 16 Intellectual Property Rights, Ethics, Health, Access, and the Environment 632

Overview 633

Intellectual Property Rights 633

- > Copyrights 634
- > Trademarks 635
- > Patents 637

Ethics 638

- > Ethical Use of Copyrighted Material 640
- > Ethical Use of Resources and Information 644

> Computer Hoaxes and Digital Manipulation 647

> Ethical Business Practices and Decision Making 649

Computers and Health 652

- > Physical Health 652
- > Emotional Health 658

Access to Technology 661

- > The Digital Divide 661
- > Assistive Technology 664

Environmental Concerns 666

- > Green Computing 666
- > Recycling and Disposal of Computing Equipment 668

Related Legislation 671

Summary 672

Review Activities 674

Projects 676

INSIDE THE INDUSTRY New Applications for Digital Watermarking 636

TECHNOLOGY AND YOU Virtual Currency—Real or Not? 639

HOW IT WORKS Digital Copy Movies 644

TREND Power to Go 669



Expert Insight on Computers and Society 678

References and Resources Guide R-1

Computer History Timeline R-2

Guide to Buying a PC R-8

- > Analyzing Needs R-8
- > Listing Alternatives R-9

A Look at Numbering Systems R-11

- > The Decimal and Binary Numbering System R-11
- > The Hexadecimal Numbering System R-11
- > Converting Between Numbering Systems R-12
- > Computer Arithmetic R-13
- > Using a Calculator R-14

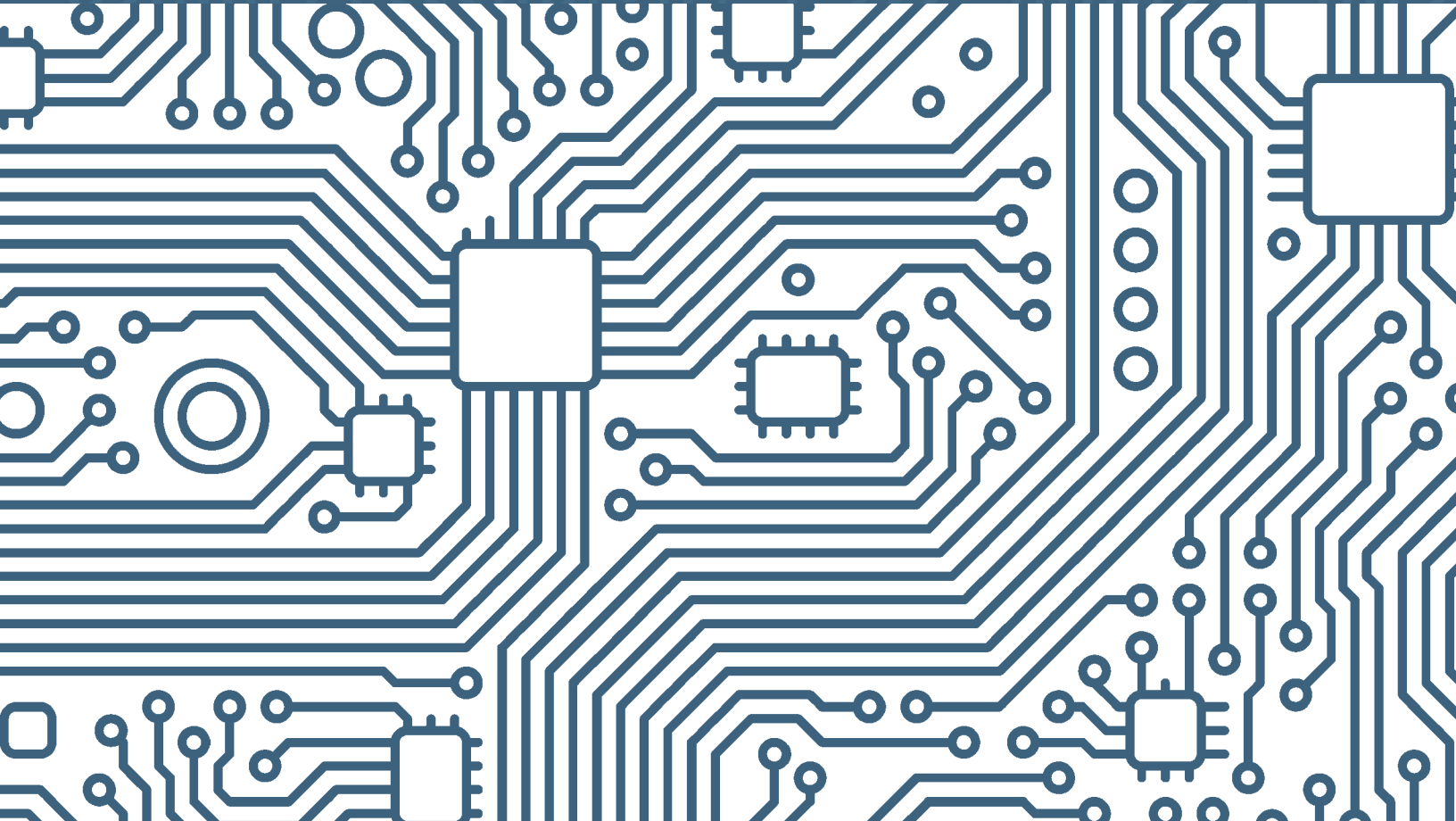
Coding Charts R-15

- > ASCII and EBCDIC R-15
- > Unicode R-16

Answers to Self-Quiz R-17**Glossary/Index I-1**

15th Edition

UNDERSTANDING COMPUTERS: TODAY AND TOMORROW





Introduction

Today, computers are virtually everywhere in our society. People encounter and use computers and computing technology many times during the average day. Individuals use personal computers and mobile devices both at home and while on the go to perform a variety of important daily tasks, such as to pay bills, shop, manage investments, communicate with others, research products, make travel arrangements, check current news and weather, look up phone numbers, and view maps of locations. They also use these devices for a growing number of entertainment purposes, such as playing games, downloading and listening to music, viewing friends' Facebook pages, and watching TV shows and movies. Businesses, schools, government agencies, and other organizations use computers and related technologies to facilitate day-to-day transactions, provide better services to customers, communicate with others, retrieve and disseminate information, and assist managers in making good decisions. Because they are so embedded in our society today, it is essential for everyone to know something about computers and what they can do.

This module introduces you to computers and some of their uses. Chapter 1 helps you to understand what computers are, how they work, and how people use them today.

Chapter 1 also provides an overview of common computer terms and concepts that you will encounter throughout this text, as well as gives you a brief look at how to use a computer to perform basic tasks and to access resources on the Internet and the World Wide Web.



in this module

Chapter 1 Introduction to the World of Computers 4

Overview 5

Computers in Your Life 5

What Is a Computer and What Does It Do? 10

Computers to Fit Every Need 19

Computer Networks and the Internet 27

Computers and Society 36



*“Software . . .
allows us to
utilize the
hardware of the
machine itself
in ways that
are seemingly
unending.”*

For more comments from
Guest Expert **Daniel Kelley**
of D-Link Systems, see the
**Expert Insight on . . .
Personal Computers**
feature at the end of the
module.



chapter 1

Introduction to the World of Computers

After completing this chapter, you will be able to do the following:

1. Explain why it is essential to learn about computers today and discuss several ways computers are integrated into our business and personal lives.
2. Define a computer and describe its primary operations.
3. List some important milestones in computer evolution.
4. Identify the major parts of a personal computer, including input, processing, output, storage, and communications hardware.
5. Define software and understand how it is used to instruct the computer what to do.
6. List the six basic types of computers, giving at least one example of each type of computer and stating what that computer might be used for.
7. Explain what a network, the Internet, and the World Wide Web are, as well as how computers, people, and Web pages are identified on the Internet.
8. Describe how to access a Web page and navigate through a Web site.
9. Discuss the societal impact of computers, including some benefits and risks related to their prominence in our society.

outline

Overview

Computers in Your Life

- Why Learn About Computers?
- Computers in the Home
- Computers in Education
- Computers on the Job
- Computers on the Go

What Is a Computer and What Does It Do?

- Data vs. Information
- Computers Then and Now
- Hardware
- Software
- Computer Users and Professionals

Computers to Fit Every Need

- Embedded Computers
- Mobile Devices
- Personal Computers (PCs)
- Servers
- Mainframe Computers
- Supercomputers

Computer Networks and the Internet

- What Are the Internet and the World Wide Web?
- Accessing a Network or the Internet
- Surfing the Web
- Searching the Web
- E-Mail

Computers and Society

- Benefits of a Computer-Oriented Society
- Risks of a Computer-Oriented Society
- Differences in Online Communications
- The Anonymity Factor
- Information Integrity

OVERVIEW

Computers and other forms of technology impact our daily lives in a multitude of ways. We encounter computers in stores, restaurants, and other retail establishments. We use computers and the Internet regularly to obtain information, experience online entertainment, buy products and services, and communicate with others. Many of us carry a mobile phone or other mobile device with us at all times so we can remain in touch with others on a continual basis and can access Internet information as we need it. We also use these devices to pay for purchases, play online games with others, watch TV and movies, and much, much more.

Businesses also use computers extensively, such as to maintain employee and customer records, manage inventories, maintain online stores and other Web sites, process sales, control robots and other machines in factories, and provide business executives with the up-to-date information they need to make decisions. The government uses computers to support our nation's defense systems, for space exploration, for storing and organizing vital information about citizens, for law enforcement and military purposes, and other important tasks. In short, computers and computing technology are used in an endless number of ways.

Understanding Computers: Today and Tomorrow is a guide to computers and related technology and how they are being used in the world today. It will provide you with a comprehensive introduction to computer concepts and terminology and give you a solid foundation for any future courses you may take that are related to computers or their use in the world today. It will also provide you with the basic knowledge you need to understand and use computers in school, on the job, and in your personal life, as well as give you an overview of the various societal issues related to technology, such as security and privacy issues, ethical considerations, and environmental concerns.

Chapter 1 is designed to help you understand what computers are, how they work, and how people use them. It introduces the important terms and concepts that you will encounter throughout this text and in discussions about computers with others, as well as includes an overview of the history of computers. It also takes a brief look at how to use a computer to perform basic tasks and to access resources on the Internet and the World Wide Web in order to provide you with the knowledge, skills, and tools you need to complete the projects and online activities that accompany this textbook. The chapter closes with an overview of the societal impact of computers. ■

COMPUTERS IN YOUR LIFE

Computers today are used in virtually every aspect of most individuals' lives—at home, at school, at work, and while on the go. The next few sections provide an overview of the importance of computers and some of the most common computer-related activities that individuals may encounter every day.

Why Learn About Computers?

Fifty years ago, computers were used primarily by researchers and scientists. Today, computers are an integral part of our lives. Experts call this trend *pervasive computing*, in which few aspects of daily life remain untouched by computers and computing technology. With pervasive computing—also referred to as *ubiquitous computing*—computers are

TIP

Most of the computer concepts introduced in this chapter are discussed in more detail in subsequent chapters of this text.

found virtually everywhere and computing technology is integrated into an ever-increasing number of devices to give those devices additional functionality, such as enabling them to communicate with other devices on an ongoing basis. Because of the prominence of computers in our society, it is important to understand what a computer is, a little about how a computer works, and the implications of living in a computer-oriented society.

Prior to about 1980, computers were large and expensive, and few people had access to them. Most computers used in organizations were equipped to do little more than carry out high-volume processing tasks, such as issuing bills and keeping track of inventories. The average person did not need to know how to use a computer for his or her job, and it was uncommon to have a computer at home. Furthermore, the use of computers generally required a lot of technical knowledge and the use of the *Internet* was reserved primarily for researchers and educational institutions. Because there were few good reasons or opportunities for learning how to use computers, the average person was unfamiliar with them.

Beginning in the early 1980s, things began to change. *Microcomputers*—inexpensive *personal computers* that you will read about later in this chapter—were invented and computer use increased dramatically. The creation of the *World Wide Web* (WWW) in the late 1980s and the graphical *Web browser* in the early 1990s started the trend of individuals buying and using computers for personal use. Today, *portable computers* and *mobile phones* have brought personal computing to a whole new level—nearly 90% of all U.S. households have a computer or mobile phone, and most individuals use some type of computer on the job. Whether you become a teacher, attorney, doctor, engineer, restaurant manager, salesperson, professional athlete, musician, executive, or skilled tradesperson, you will likely use a computer to obtain and evaluate information, to facilitate necessary on-the-job tasks, and to communicate with others. Today's computers are very useful tools for these purposes; they are also taking on new roles in our society, such as delivering entertainment on demand. In fact, computers and the traditional communications and entertainment devices that we use every day—such as telephones, televisions, gaming devices, and home entertainment systems—are *converging* into single units with multiple capabilities. For instance, you can check your *e-mail* (electronic messages), watch videos, and view other Internet content on your living room TV; you can make telephone calls via your personal computer; and you can view Internet content and watch TV on your *smartphone* or other *mobile device* (see Figure 1-1). As a result of this *convergence* trend, the computer is no longer an isolated productivity tool; instead, it is an integral part of our daily lives.

Just as you can learn to drive a car without knowing much about car engines, you can learn to use a computer without understanding the technical details of how a computer works. However, a little knowledge gives you a big advantage. Knowing something about cars can help you make wise purchasing decisions and save money on repairs. Likewise, knowing something about computers can help you buy the right one for your needs, get the most efficient use out of it, be able to properly *upgrade* it as your needs change, and have a much higher level of comfort and confidence along the way. Therefore, basic **computer literacy**—knowing about and understanding computers and their uses—is an essential skill today for everyone.



TIP

More than half of all U.S. mobile phone users today are *smartphone* users; that is, their mobile phones include Internet capabilities and the ability to run mobile programs or *apps*.



FIGURE 1-1

Convergence.

Many devices today include computing or Internet capabilities.



Courtesy Netflix

TELEVISIONS

Can be used to access Web pages, e-mail, streaming movies, and other Internet content, in addition to viewing TV content.



Used with permission from Microsoft Corporation

SMARTPHONES

Can be used to access Internet content, play music and games, take photos, watch TV shows, and more, in addition to making phone calls.

> **Computer literacy.** The knowledge and understanding of basic computer fundamentals.

Computers in the Home

Home computing has increased dramatically over the last few years as computers and Internet access have become less expensive and as a vast array of online consumer activities have become available. Use of the Internet at home to look up information, exchange e-mail, shop, watch TV and videos, download music and movies, research products, pay bills and manage bank accounts, check news and weather, store and organize *digital photos*, play games, make vacation plans, and so forth is now the norm for many individuals (see Figure 1-2). Many individuals also use a computer at home for work-related tasks, such as to review work-related documents or check work e-mail from home.

As the Internet, wireless technology, and devices such as computers, televisions, mobile phones, *digital video recorders (DVRs)*, and *gaming consoles* continue to converge, the computer is also becoming a central part of home entertainment. *Wireless networking* allows the use of computers in virtually any location and both online and offline content to be sent wirelessly from one device to another. Both voice and video telephone calls can be made over your Internet connection, and your TV can display Internet content.

Computing technologies also make it possible to have *smart appliances*—traditional appliances (such as refrigerators, thermostats, or ovens) with some type of built-in computer or communications technology that allows them to be controlled by the user via a smartphone or the Internet, to access and display Internet information, or to perform other computer-related functions. *Smart homes*—homes in which household tasks (such as watering the lawn, turning the air conditioning on or off, making coffee, monitoring the security of the home and grounds, and managing home entertainment content) are controlled by a main computer in the home or by the homeowner remotely via a smartphone—have arrived, and they are expected to be the norm in less than a decade. Some believe that one primary focus of smart appliances and smart homes will be energy conservation—for instance, the ability to perform tasks (such as running the dishwasher and watering the lawn) during nonpeak energy periods and to potentially transfer waste heat from one appliance (such as an oven) to another appliance (such as a dishwasher) as needed.

Computers in Education

Today's youth can definitely be called the *computing generation*. From *handheld gaming devices* to mobile phones to computers at school and home, most children and teens today have been exposed to computers and related technology all their lives. Although the amount of computer use varies from school to school and from grade level to grade level, most students today have access to computers at school—and some schools have completely integrated computers into the curriculum, such as by adopting *e-book* (electronic) textbooks that run on school-owned portable computers, or allowing students to bring in devices to use in class (referred to as *BYOD* or *Bring Your Own Device*). Many schools (particularly college campuses) today also have *wireless hotspots* that allow students to connect their personal computers or mobile devices wirelessly to the Internet from anywhere on campus. Today, students at all levels are typically required to use a computer to some extent as part of their normal coursework—such as for preparing papers, practicing skills, doing Internet research, accessing Internet content (for instance, class *Web pages* or their campus *YouTube* channel), or delivering presentations—and some colleges require a computer for enrollment.

Computers are also used to facilitate *distance learning*—an alternative to traditional classroom learning in which students participate, typically at their own pace, from their current location (via their computers and Internet connections) instead of physically going to class. Consequently, distance learning gives students greater flexibility to schedule class time around



© tokyoimages/Shutterstock.com



REFERENCE

Retrieving information, obtaining news, viewing recipes, shopping online, and exchanging e-mail are popular home computer activities.



© miron10v/Shutterstock.com

PRODUCTIVITY

Home computers are frequently used for editing and managing digital photos and home videos, creating and editing work-related documents, paying bills, and other productivity tasks.



© iStockphoto.com/Ridofranz

ENTERTAINMENT

Home computers and gaming consoles are becoming a central hub for entertainment, such as the delivery of photos, videos, music, games, TV shows, instant messages, and social networking updates.

FIGURE 1-2
Computer use at home.



© Goodluz/Shutterstock.com

COMPUTER LABS AND CLASSROOMS
 Many schools today have computers and Internet access available in the classroom and/or a computer lab for student use.



© iStockphoto.com/sturti

CAMPUS WIRELESS HOTSPOTS
 Many students can access the Internet from anywhere on campus to do research, check e-mail, and more, via a campus hotspot.



Denver Makle, 7th Army JIMTC

DISTANCE LEARNING
 With distance learning, students—such as these U.S. Army soldiers—can take classes from home or wherever they happen to be at the moment.

FIGURE 1-3
 Computer use in education.

their personal, family, and work commitments, as well as allows individuals located in very rural areas or stationed at military posts overseas to take courses when they are not able to attend classes physically. Some examples of computer use in education are shown in Figure 1-3.

FIGURE 1-4
 Computer use on the job.

Computers on the Job

Although computers have been used on the job for years, their role is continually evolving. Computers were originally used as research tools for computer experts and scientists and

then as productivity tools for office workers. Today, computers are used by all types of employees in all types of businesses—including corporate executives, retail store clerks, traveling sales professionals, artists and musicians, engineers, police officers, insurance adjusters, delivery workers, doctors and nurses, auto mechanics and repair personnel, and professional athletes. In essence, the computer has become a universal tool for on-the-job decision making, productivity, and communications (see Figure 1-4). Computers are also used extensively for access control at many businesses and organizations, such as *authentication systems* that allow only authorized individuals to enter an office building, punch in or out of work, or access the company network via an access card or a fingerprint or hand scan, as shown in Figure 1-4 and discussed in detail in Chapter 9. In addition to jobs that require the use of computers by employees, many new jobs have been created simply because computers exist, such as jobs in electronics manufacturing, online retailing, Internet applications, and technology-related computer support.



© iStockphoto.com/sturti

DECISION MAKING
 Many individuals today use a computer to help them make on-the-job decisions.



© Monkey Business Images/Shutterstock.com

PRODUCTIVITY
 Many individuals today use a computer to perform on-the-job tasks efficiently and accurately.



© iStockphoto.com/fstop123

OFF-SITE COMMUNICATIONS
 Many individuals use portable computers or mobile devices to record data, access data, or communicate with others when they are out of the office.



Courtesy Ingersoll Rand

AUTHENTICATION
 Many individuals are required to use authentication systems to punch in and out of work, access facilities, or log on to company computers.

TECHNOLOGY AND YOU

Restaurant iPad Ordering Systems

You may have used your iPad or other device to place a pickup order at your local eatery; you may also have had a server use an iPad to take your order at a restaurant. Nice innovations, but guess what's next? Placing your order yourself at a restaurant using an iPad.

This new trend of using iPads and *e-menus* to have customers place their orders in restaurants is growing rapidly. In addition to enabling customers to place their orders at their convenience without waiting for a server, it also allows the restaurant to provide more resources to customers (such as photographs of menu items, pairing suggestions for appetizers and drinks, and so forth). The overall goal is to allow customers to control their dining experience from the time they are seated until they choose to pay the check. And, yes, they pay via the iPad as well (see the credit card reader at the top right of the iPad shown in the accompanying photo).

iPad ordering systems work especially well for restaurants that offer customized menu items. For example, Stacked, one of the first large-scale adopters of restaurant iPad ordering systems, offers typical American food (such as pizza, burgers, and salads) at its Southern California restaurants but everything on the menu is customizable—customers choose from a wide variety of ingredients, toppings, and sauces. The iPad systems enable customers to build their selections, adding or removing ingredients, until they are satisfied with the order (the price adjusts as they change their selections). This allows customers to build their orders at a comfortable pace without having to remember them until a server arrives, or having to make that many decisions with a server waiting.

More than 7,000 e-menu-enabled iPads are also arriving at airport restaurants in three airports in North America. They will be used not only for placing orders but also for providing travelers with free access to Facebook, Twitter, e-mail, games, news, and flight updates while they wait (for security purposes, all personal information is wiped from the device as soon as the home button is pressed).

The two biggest risks for restaurants introducing iPad ordering systems is customer acceptance (most offer assistance from servers if the customer desires to help alleviate any customer concerns about using the devices) and technology issues. To avoid network or Internet outage issues, some restaurants are implementing redundant systems, such as multiple routers that can be used if the main router goes down or a 4G Internet connection that the system can use to access the Internet via a cellular connection if the main Internet source goes down.



Courtesy of Square, Inc.

Computers are also used extensively by military personnel for communications and navigational purposes, as well as to control missiles and other weapons, identify terrorists and other potential enemies, and perform other necessary national security tasks. To update their computer skills, many employees in all lines of work periodically take computer training classes or enroll in computer certification programs.

Computers on the Go

In addition to using computers in the home, at school, and on the job, most people encounter and use all types of computers in other aspects of day-to-day life. For example, it is common for consumers to use *consumer kiosks* (small self-service computer-based stations that provide information or other services to the public, including those used for ATM transactions, bridal registries, ticketing systems, and more), *point-of-sale (POS) systems* (such as those found at most retail stores to check customers out—see the Technology and You box for a look at how you may soon be using iPads to order at restaurants), and *self-checkout systems* (which allow retail store customers to scan their purchases and pay