16th Edition

Understanding COMPUTERS

Today and Tomorrow

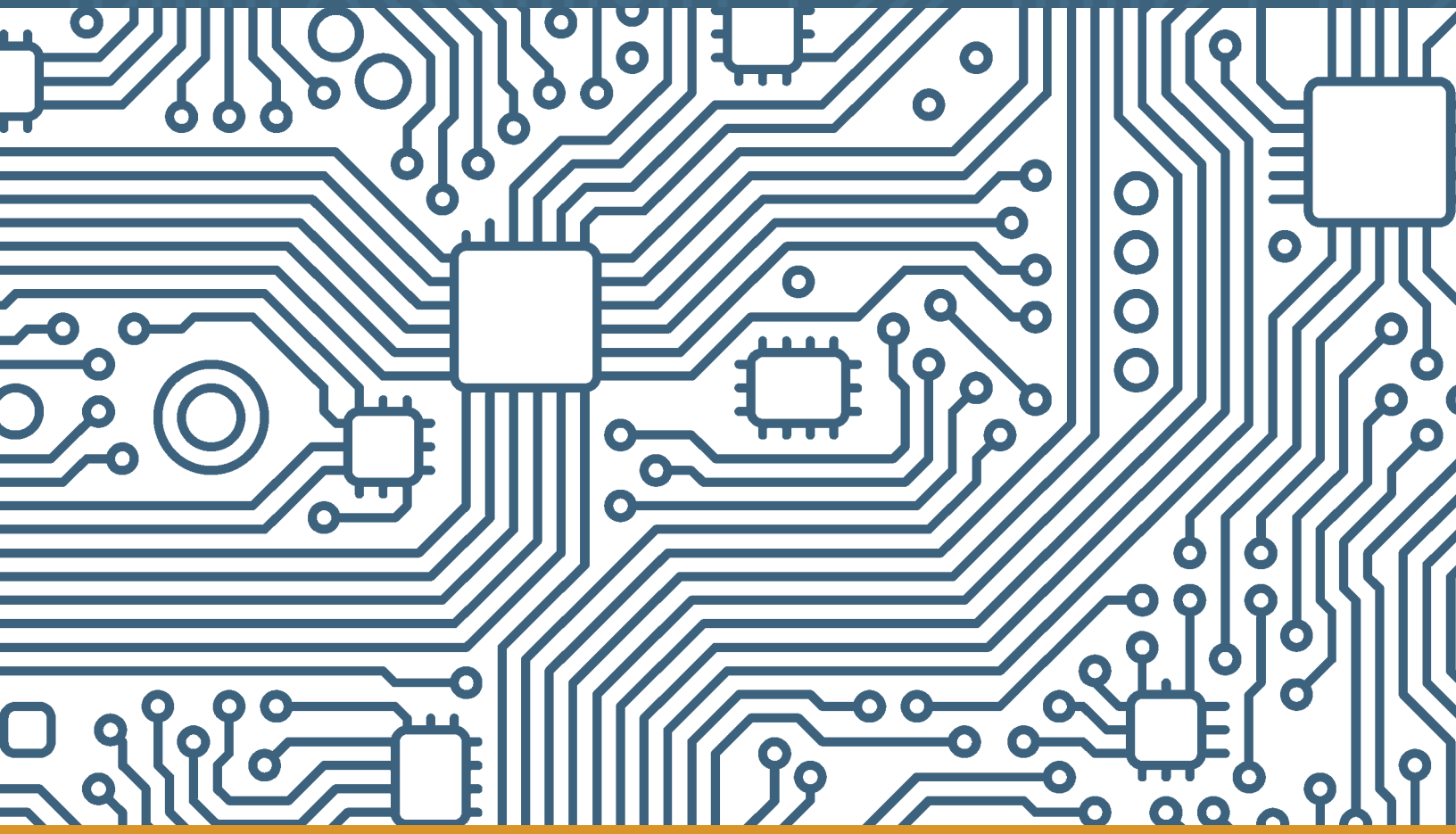
COMPREHENSIVE

Deborah Morley
Charles S. Parker

16th Edition

UNDERSTANDING COMPUTERS:

TODAY AND TOMORROW



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PREFACE

In today's technology-oriented society, computers and technology impact virtually everyone's life. *Understanding Computers: Today and Tomorrow, 16th 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.

WHAT'S NEW IN THIS EDITION?

Accommodating a wide range of teaching styles, *Understanding Computers: Today and Tomorrow, 16th 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, social media, and smart devices, and includes the following new topics:

- New hardware developments, including flexible smartphones, modular smartphones, self-driving cars, Apple Watch and other wearables, USB 3.0 and 3.1, USB-C, smart clothing, HAMR (heat-assisted magnetic recording) hard drives, neuromorphic chips, graphene chips, Intel Compute Stick and other thumb drive PCs, Surface Hub, portable 3D scanners, Ultra HD (4K) displays, Microsoft HoloLens, silk ink and protein ink, Amazon Echo, drones, and robot butlers and orderlies.
- New software developments, including Windows Edge, Windows 10, OS X El Capitan and OS X Yosemite, Android Marshmallow, iOS 9, Firefox OS, Tizen, Cortana, crapware, Office 2016, Web site builders, social commerce, mobile UX (user experience), NoSQL databases, and new programming languages such as F# and B#.
- New mobile applications, including smartphone drivers licenses, digital watermark icons, Bitcoins and other mobile payment options, biometric authentication, and Apple Pay and other digital wallets.
- New networking technologies, including personal clouds, Google Fiber, 802.11ax, 802.11af (White-Fi), 802.11ah (Low Power Wi-Fi), LTE-Advanced, LTE-Unlicensed (LTE-U), 5G, and point-to-multipoint (PMP) and point-to-point (PP) networks.
- New security and privacy risks and precautions, including waterproof smartphones, Transport Layer Security (TLS), tracking cookies, skimming and EMV credit cards, digital IDs, and privacy issues surrounding wearable devices.

In addition, the textbook has been streamlined for more efficient coverage and is now a total of 13 chapters instead of 16 chapters to make it easier to teach this course in a single semester. Key changes include:

- The security and privacy topics from Chapter 15 in previous editions are now combined with the network and Internet security topics in Chapter 9 so that all of the computer, network, and Internet security and privacy topics are included in a single chapter (Chapter 9).
- Key multimedia and e-commerce concepts from Chapters 10 and 11 in previous editions have been moved into appropriate chapters in this edition.

KEY FEATURES

Just like its previous editions, *Understanding Computers: Today and Tomorrow, 16th 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, tablets, mobile apps, wearables, and the issues that surround them, such as security and privacy. 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.

60 HARDWARE

TECHNOLOGY AND YOU

Modular Phones

Want to easily replace your cracked smartphone screen or add a new feature? You may soon be in luck if modular phones become a reality. Currently in the development and testing stages, modular phones (such as Google's *Project Ara* prototype shown in the accompanying photo) allow individuals to create custom phones with the functions, modules, and appearance they wish. Modular phones start with basic modules (such as modules for the processor, memory, battery, camera, and screen) and then additional modules can be added as needed. Modules can be safely inserted and removed from the phone's basic endoskeleton, even while the device is powered on. In addition to enabling individuals to initially build the phone they want, modular phones give the user flexibility to add new modules whenever they are needed and only for as long as they are needed, such as to use a telephoto lens or heart rate monitor temporarily. Modular phones also reduce e-waste by enabling individuals to upgrade just the modules they need or replace only the module that is broken (such as sliding out a cracked screen module and inserting a new one), instead of discarding an old phone for an entirely new one.

Google's modular smartphone prototype.

from the ones used in personal computers and determine the processing capabilities of the device. For a look at an emerging type of smartphone that uses modules for the processor and other components, see the Technology and You box.

Processing Speed

One measurement of the *processing speed* of a CPU is the *CPU clock speed*, which is typically rated in *megahertz (MHz)* or *gigahertz (GHz)*. A CPU with a higher CPU clock speed means that more instructions can be processed per second than the same CPU with a lower CPU clock speed. For instance, a Core i7 processor running at 3.2 GHz would be faster than a Core i7 processor running at 2.66 GHz if all other components remain the same. CPUs for the earliest personal computers ran at less than 5 MHz; today's fastest CPUs

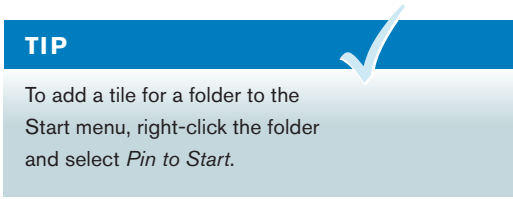
Readability

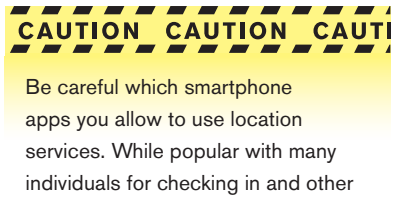
We remember more about a subject if it is made interesting and exciting, as well as presented in a straightforward manner. This book is written in a conversational, down-to-earth style—one designed to be accurate without being intimidating. Concepts are explained clearly and simply, without the use of 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 technology

is used on the job or otherwise in the real world along with the response from an expert. Experts for this edition include a former Navy pilot, a guitarist from a rock band, an iOS software engineer from WillowTree Inc., a professional animator, and executives from notable companies like McDonald's, Microsoft, SONIC, Reddit, Dice, iRobot, Western Digital, Coursera, Logitech, SanDisk, Kingston, Seagate, The Linux Foundation, ACM, Rhapsody, The Computer Ethics Institute, Sony Animations, D-Link, GreenDisk, The Unicode Consortium, ARM, Arubixs, Infodatix, Trustwave, and Symantec.





5. **Marginal Tips and Caution Elements**: **Tip** marginal elements feature time-saving tips or ways to avoid a common problem or terminology mistake, or present students with interesting additional information related to the chapter content. **Caution** elements warn of a possible problem students should avoid.

6. **Illustrations and Photographs**: Instructive, current, full-color illustrations and photographs are used to illustrate important concepts. Figures and screenshots show the latest hardware and software and are annotated to convey important information.

7. **Summary and Key Terms**: The end-of-chapter material includes a concise, section-by-section **Summary** of the main points in the chapter. The chapter's Learning Objectives appear in the margin next to the relevant section of the summary so that students are better able to relate the Learning Objectives to the chapter material. Every boldfaced key term in the chapter also appears in boldface type in the summary.

8. **Review Activities**: End-of-chapter **Review Activities** allow students to test themselves on what they have just read. A matching exercise of selected **Key Terms** helps students test their retention of the chapter material. A **Self-Quiz** (with the answers listed at the end of the book) consists of ten true-false and completion questions. Five additional easily graded matching and short-answer **Exercises** are included for instructors who would like to assign graded homework. Two short **Discussion Questions** for each chapter provide a springboard to jump-start classroom discussions.

9. **Projects**: End-of-chapter **Projects** require students to extend their knowledge by doing research and activities beyond merely reading the book. Organized into six types of projects (**Hot Topics**, **Short Answer/Research**, **Hands On**, **Ethics in Action, Presentation/Demonstration**, and **Balancing Act**), the projects feature explicit instructions so that students can work through them without additional directions from instructors. A special marginal icon denotes projects that require Internet access.

References and Resources Guide

A **References and Resources Guide** at the end of the book brings together in one convenient location a collection of computer-related references and resources, including a **Computer History Timeline**, a **Guide to Buying a PC**, **A Look at Numbering Systems** feature, and a **Coding Charts** feature.

expert insight on...

Computers and Technology

A conversation with DANIEL KELLEY
Vice President, Marketing, D-Link Systems, Inc.

"Technology advancements, such as the use of 3D printers to create live tissue that can be used for replacing lost body parts, can have a very positive impact on our health and wellness."

My Background . . .

As the Vice President of Marketing for D-Link Systems, Inc., I am responsible for the overall marketing and branding of the company and its products. My focus is on creating demand and loyalty from customers through a range of disciplines including advertising, sponsorships, press relations, social media, and channel marketing. Although I hold a degree in communications, which helped launch my career in marketing, I attribute most of my skills to real-world marketing experience and constantly challenging myself to learn and stay on top of the latest marketing tactics, platforms, and trends.

It's Important to Know . . .

The evolution from the first massively sized computers to today's small devices, such as the iPhone, has created a major shift in the industry. Once the average consumer could get a powerful PC in his or her home, it started what we now view as the natural integration of technology in our daily lives. Putting a full-fledged computer with virtually unlimited potential into one's pocket has changed how we interact with information and with others in ways we're still discovering.

Software is the interactive way a customer sees and uses a device, such as a PC, tablet, or phone. Software—in the form of applications (or apps)—allows us to utilize the hardware of the machine itself in ways that are seemingly unending.

Social media's influence will continue to grow and impact how we communicate. The noticeable shift from customers trusting impersonal third-party reviews of products and services to those of friends, family members, and others via social media sites is changing the way businesses market themselves and communicate with customers. We've also seen a rapid adoption of photo-focused and short video platforms such as Vine and Instagram, which is a key indicator that individuals are looking to capture and share more photos and videos not only for entertainment but also for everyday interactions.

How I Use this Technology . . .

Growing up, I always had an interest in all things creative and spent much of my time drawing, painting, and doing other creative projects. I carried this interest through my education, learning design graphics, animation, video, and Web development programs. The knowledge of these programs and my eye for design helps me provide direction on creative projects and allows me to dive in and give more specific examples or direction as needed. Today, I also use a laptop, tablet, and my smartphone every day to work and communicate with others from home, the office, and while traveling. My most used app is Evernote, which helps me create and keep track of notes and ideas across all of my devices.

D-Link

Daniel Kelley is the Vice President of Marketing for D-Link Systems, Inc., and is responsible for connectivity solutions tailored for home and business users. He has more than 15 years of professional marketing experience and holds a Bachelor of Arts degree in communications. As a result of Daniel's leadership and thriving marketing programs, many of the programs initiated in North America, including the implementation of numerous social media campaigns hosted on D-Link's social media platforms, have been adopted worldwide.

MODULE INTRODUCTION 47

What the Future Holds . . .

One of the trends I personally find the most interesting is the rapid evolution of wearable technology. With the introduction of Google Glass and wellness-focused products such as FitBit, I see a very rapid adoption of new solutions designed to integrate technology with our clothing and accessories, which will lead to an entirely new way of interacting with information in our daily lives. We've become empowered in ways never dreamed of just decades ago, with endless information and new communication vehicles at our fingertips, and we've seen a rapid and dramatic shift from face-to-face conversations and phone calls to texting, e-mail, and social media as preferred ways to communicate. This shift will continue to accelerate, with video calls and video messages becoming a primary communication medium. However, we have to be careful we don't become more isolated and detached from others in public social situations so we can continue to interact positively with each other in the future.

"As we put more of ourselves out there in the cloud, we make ourselves more vulnerable."

Another concern for the future is privacy. As we put more of ourselves out there in the cloud, we make ourselves more vulnerable. With any new technology or service, there are going to be those looking to exploit it and cause harm to others for personal gain and we've seen how private information doesn't necessarily remain private. This should encourage individuals to protect themselves as much as possible, such as using strong online passwords and just using common sense when determining what to share online.

I'm hoping that one of the biggest impacts of technology in the future is in the medical field or solving big problems like world hunger. Technology advancements, such as the use of 3D printers to create live tissue that can be used for replacing lost body parts, can have a very positive impact on our health and wellness. This same 3D printing technology has the potential to create a large food supply (utilizing protein "ink" from meal worms, for instance) for third-world countries where food is desperately needed. As much as technology advances our entertainment and social interaction, I am more interested to see how it can actually improve how we take care of those in need.

My Advice to Students . . .

Jump in with both feet. Take things apart, build things, and constantly learn new things through education and resources such as the Internet and books. We are living in a truly remarkable time where opportunities abound in the tech field, and those who apply themselves and commit to learning, trying, and doing will have an upper hand for building a career or leading the next wave of where technology can take us.

Discussion Question

Daniel Kelley views emerging technology, such as 3D printers, as a possible way to solve world hunger and to facilitate medical advancements. What technological, legal, and ethical issues may need to be resolved before we use 3D printers to print replacement body parts or food? How, if at all, should use of these devices be regulated? What if people want to use the technology to create additional body parts for a fashion statement—do you foresee that becoming an issue in the future? Why or why not? Be prepared to discuss your position (in class, via an online class forum, or via a class blog, depending on your instructor's directions). You may also be asked to write a short paper expressing your opinion.

For more information about D-Link, visit the official Web site at us.dlink.com. D-Link also communicates through social sites (facebook.com/dlink and twitter.com/dlink), and has a resource center located at resource.dlink.com.

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**, **Intel Security**, **ACM/Google**, and **eBay**—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!

MindTap

The digital version of *Understanding Computers 16th Edition* is available in **MindTap**, a personalized online learning platform. In addition to the digital version of the book, MindTap includes flashcards, quizzing, online videos, activities, and more based on an instructor-designed learning path that guides students through the course. MindTap is a cost-effective alternative to a printed textbook. Students can purchase access to MindTap from www.cengagebrain.com. The MindTap for this book includes:

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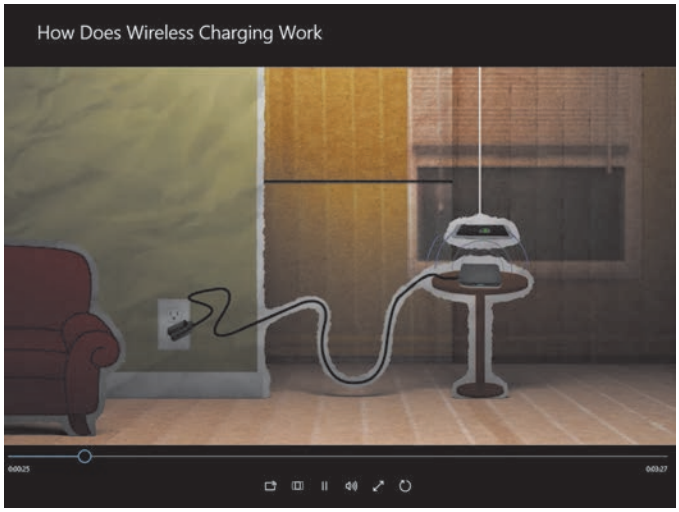

Courtesy Tinkernut.com

- **Flashcards**—allow students to test their knowledge of selected chapter key terms.
- **Quizzing**—allows students to test their retention of chapter concepts.
- **SAM Concepts**—provides training videos and hands-on reinforcement activities and assessments on hundreds of computer tasks and topics.
- **Chapter Study Guides**—consist of downloadable study guides for each chapter that can help students prepare for exams.
- **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.

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.

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!

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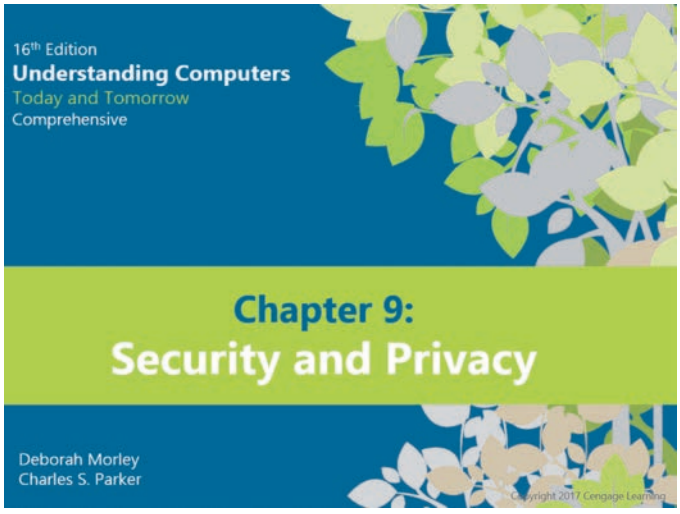
PowerPoint Presentations

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.



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SAM

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Deborah Morley
Charles S. Parker

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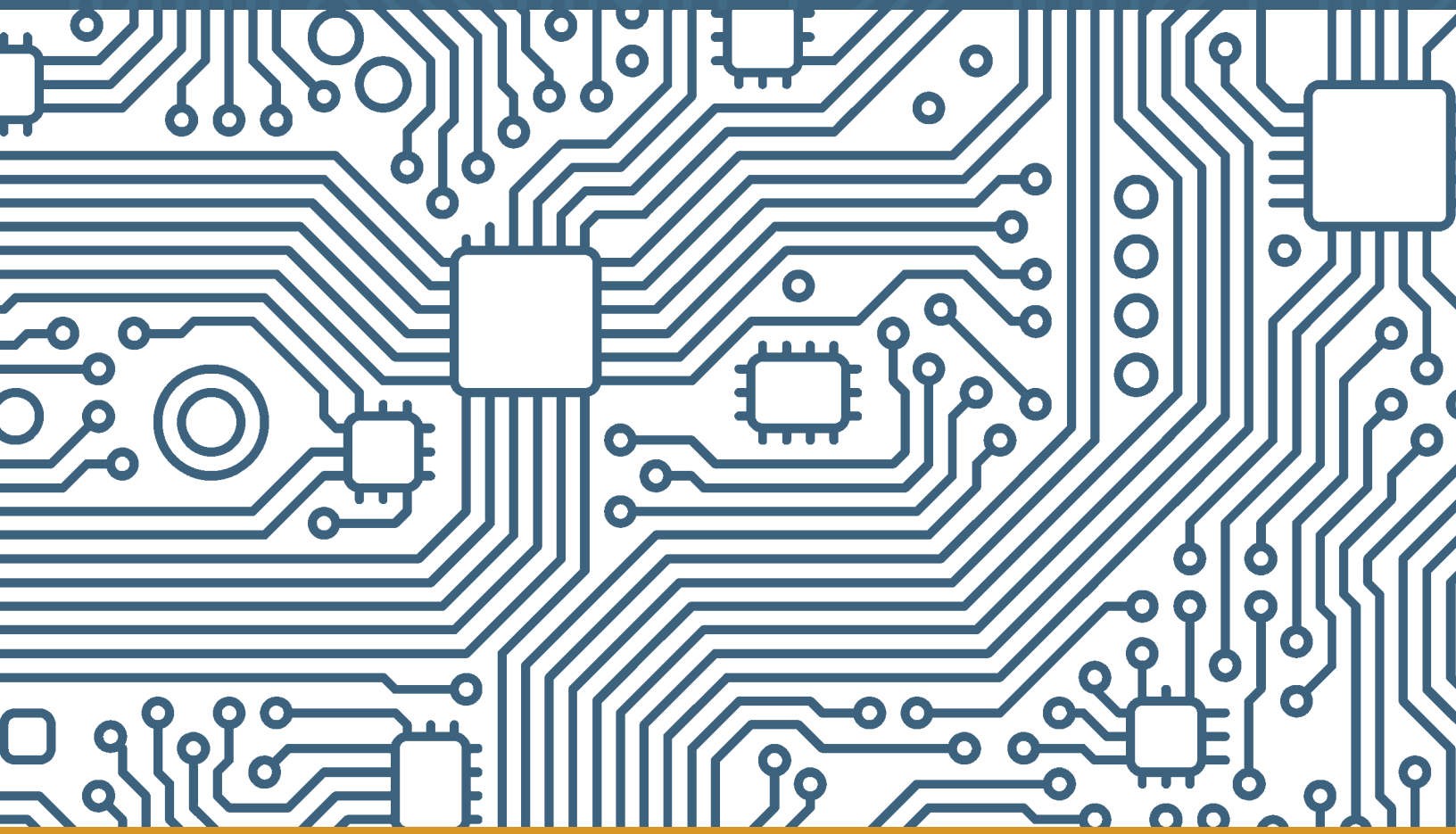
16th Edition

UNDERSTANDING COMPUTERS:

TODAY AND TOMORROW



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module

Introduction

Today, computers and other technology are virtually everywhere in our society. People encounter and use computers and technology many times during the average day. Individuals use computing devices and the Internet 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 related technology. 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 perform basic computing tasks and to access resources on the Internet and the World Wide Web.

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Technology and Society 36

"The evolution from the first massively sized computers to today's small devices, such as the iPhone, has created a major shift in the industry."

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

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chapter 1

Introduction to the World of Technology

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

1. Explain why it is essential to learn about technology today and discuss several ways computing devices 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 computing device and stating what that type of device 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 and technology, including some benefits and risks related to their prominence in our society.

outline

Overview

Technology in Your Life
- Why Learn About Computers and Technology?
- Computing Devices in the Home
- Computing Devices in Education
- Computing Devices on the Job
- Computing Devices 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

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

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INT

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 or smartphones and the Internet regularly to obtain information, experience online entertainment, buy products and services, and communicate with others. Many of us carry a smartphone 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, access real-time traffic conditions, 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 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 technology or its use in the world today. It will also provide you with the basic knowledge you need to understand and use computing devices in school, on the job, and in your personal life, as well as give you an overview of the 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 technology today. It introduces the important terms and concepts that you will encounter throughout this text and in discussions about technology 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 online resources 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. ■

TIP

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

TECHNOLOGY IN YOUR LIFE

Computers and other technologies are integrated into 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.

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Why Learn About Computers and Technology?

Fifty years ago, computers were used primarily by researchers and scientists. Today, computers and technology 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 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 retrieve *Internet* information or 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 technology-oriented society.

Prior to about 1980, computers were large and expensive, and few people had access to them. Most computers in organizations were used for 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.

TIP

About two-thirds 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.

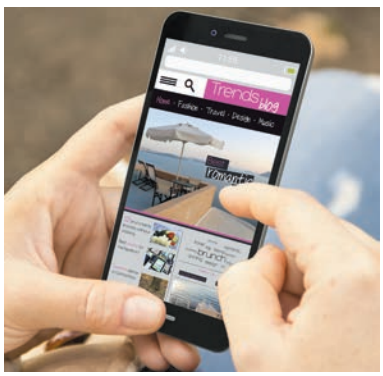
Beginning in the early 1980s, things began to change. *Microcomputers*—inexpensive *personal computers* that you will read about later in this chapter—were invented and computer use increased dramatically. The creation of the *World Wide Web* (*WWW*) in the late 1980s and the graphical *Web browser* in the early 1990s started the trend of individuals buying and using computers for personal use. Today, the vast majority of U.S. households have a computer or smartphone, and most individuals use some type of computing device 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.

In addition to being very useful tools, today's computers are 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, and gaming devices—are *converging* into single units with multiple capabilities. For instance, you can check your *e-mail* 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* (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.

FIGURE 1-1
Convergence. Many devices today include computing or Internet capabilities.

Source: Amazon.com, Inc.

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



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SMARTPHONES
Can be used to access Web pages, e-mail, movies, and other Internet content; play music; run apps and games; and take photos, in addition to making phone calls.

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,

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basic **computer literacy**—knowing about and understanding computers and their uses—is an essential skill today for everyone.

Computing Devices in the Home

Home computing has increased dramatically over the last few years as computers, smartphones, and the Internet have become mainstream, 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, smartphones, 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.

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 smart 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.

Computing Devices 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 computers or smartphones 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 devices wirelessly to the Internet and to campus resources 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 (such as class *Web pages*), 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

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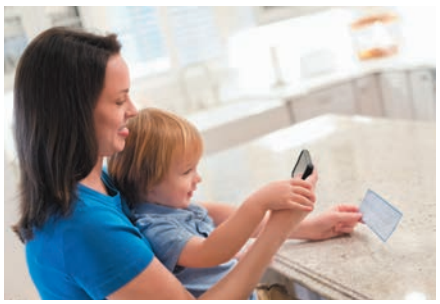
REFERENCE
Retrieving information, obtaining news, viewing recipes, shopping online, and exchanging e-mail are popular reference activities.



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PRODUCTIVITY
Online banking and shopping, editing and managing digital photos and home videos, creating and editing work-related documents, and paying bills are common productivity tasks.

Source: Roku, Inc.

ENTERTAINMENT
Watching online TV and movies, viewing photos and videos, playing games, and viewing Web content are popular entertainment activities.

FIGURE 1-2
Technology use at home.

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

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COMPUTER LABS AND CLASSROOMS
Computers and Internet access are often available in the classroom and/or a computer lab for student use.

iStockphoto.com/Steve Debenport

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

Source: Denver Makle, 7th Army JMTC

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
Technology use in education.

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 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 technology in education are shown in Figure 1-3.

Computing Devices 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. 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.

FIGURE 1-4
Technology use on the job.

iStockphoto.com/sturti

DECISION MAKING
Computers are used to help make on-the-job decisions.

iStockphoto.com/sturti

PRODUCTIVITY
Computers are used to perform on-the-job tasks efficiently and accurately.

iStockphoto.com/fstop123

OFF-SITE COMMUNICATIONS
Portable devices are used to record data, access data, or communicate with others.

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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.

E-menu-enabled iPads are also used at some airport restaurants for other purposes. In addition to being used for placing orders, they provide 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.

Source: 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.

Computing Devices 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 computing devices 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 and bridal registries), *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 iPads are being used to place orders at restaurants), and *self-checkout systems* (which allow retail store customers to scan their purchases and pay for them without a salesclerk) in retail stores and other public locations.

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