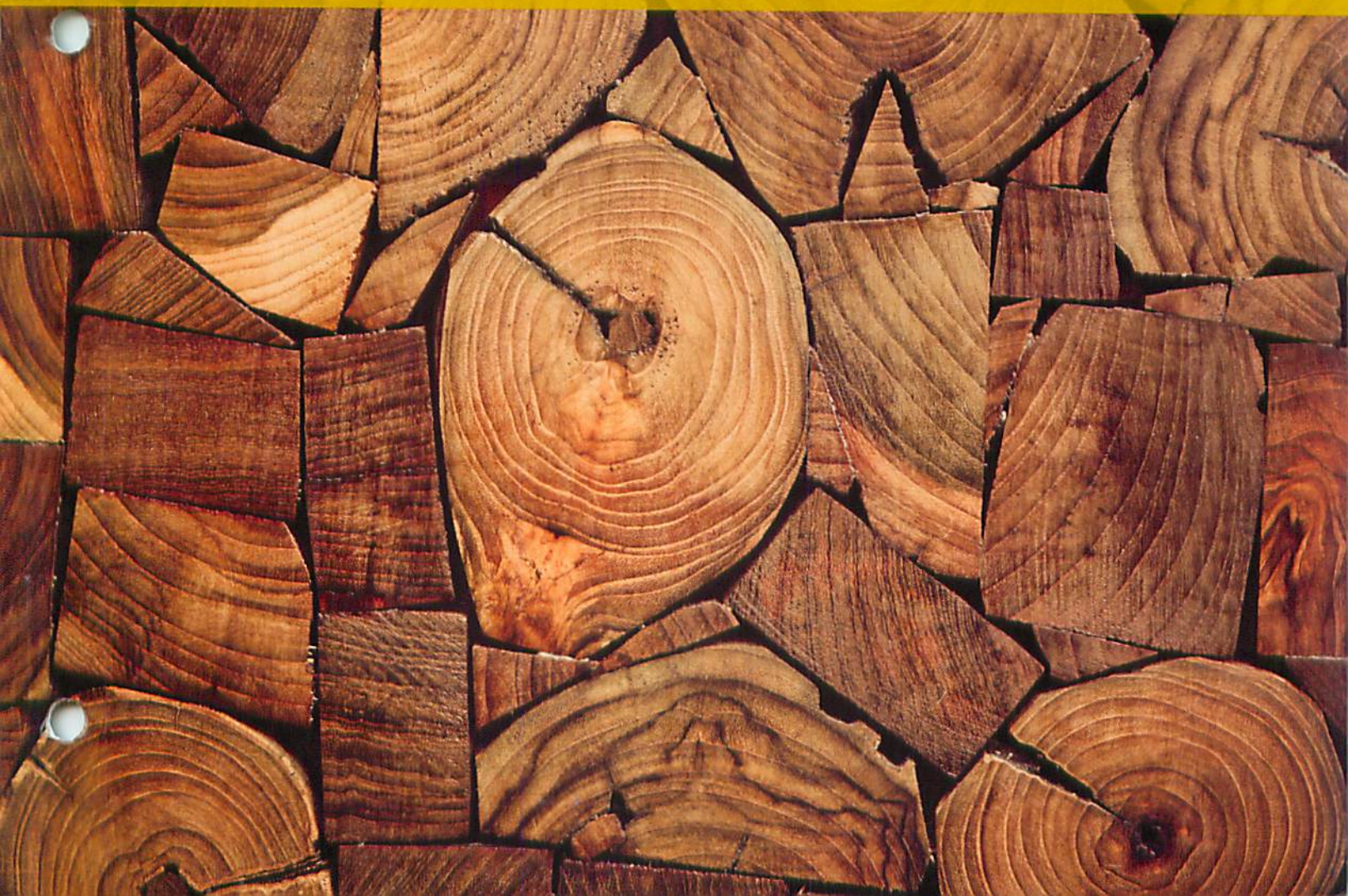
NEW PERSPECTIVES

PARSONS

Computer Concepts 2018

Introductory



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***New Perspectives on Computer Concepts, 2018,* Introductory**
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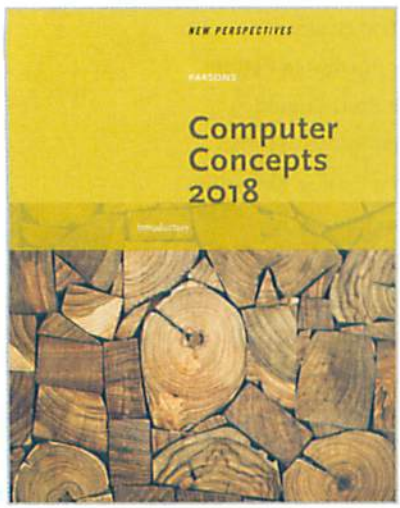


COLLEGE GRADUATES OF THE 21ST CENTURY

are expected to have a **BROAD BASE OF KNOWLEDGE** to intelligently address social, political, economic, and legal issues associated with rapidly evolving digital technology.

Today's students have a patchwork of knowledge, acquired from using various digital devices. *New Perspectives on Computer Concepts* (NP2018) helps students build a cohesive framework that organizes this acquired knowledge and serves as a foundation for assimilating new concepts **ESSENTIAL TO CAREERS AND LIFESTYLES** in our digital world.

FULLY REVISED. NP2018 has been newly **REVISED AND UPDATED** to increase learning effectiveness and to reflect the wide scope of digital devices in use today, with an enhanced focus on the connectivity that pervades modern life and the security necessary to protect it.

TARGETED LEARNING SUPPORT. This award-winning textbook contains layers of targeted learning support for **ACTIVE LEARNING** that keeps students engaged and helps them succeed. Using the **MINDTAP DIGITAL PLATFORM**, students benefit from interactive feedback and new collaborative opportunities.

READING IN THE DISCIPLINE. Short paragraphs and a clear narrative style help students grasp concepts and learn **HOW TO READ TECHNICAL MATERIAL**.

RETENTION. What's the most effective study technique: Taking notes? Reviewing? According to researchers, students study most effectively by simply trying to recall the material they've read, seen, or heard. That's why NP2018 offers **CONTINUOUS ASSESSMENT**. Embedded QuickChecks on just about every page help students recall key concepts while reading and later while reviewing. QuickQuizzes and end-of-module reinforcement promote **SUCCESSFUL LEARNING OUTCOMES**.

HANDS-ON. NP2018 contains plenty of practical information about how to use apps, manage files, create content, configure security software, and more. Try It! activities throughout the book show students how to **IMMEDIATELY APPLY CONCEPTS IN REAL-WORLD CONTEXTS**.

FLIPPED CLASSROOMS. Flipping a course is easy with NP2018, which includes flipped class projects for **CRITICAL THINKING**, cyberclassroom exploration, **COLLABORATIVE GROUP WORK**, multimedia integration, career building, and **GLOBALIZATION**. End-of-module features, such as Issues and Information Tools, offer additional topics for hands-on in-class activities.

EXTENDED INTRO MODULE. The Introduction module puts technology into context with in-depth coverage of the multi-phased digital revolution. For NP2018, this introduction has been expanded to include **VIRTUAL REALITY, AUGMENTED REALITY, AND AUTONOMOUS VEHICLES**.

A FRESH APPROACH TO SOCIAL MEDIA. Sure, students use social media, but are they familiar with underlying concepts, such as the **SOCIAL MEDIA HONEYCOMB, GEOLOCATION, AND SOCIOGRAMS**? Are they up to speed with Creative Commons and intellectual property concepts? Do they recognize **FAKE NEWS**? And do they understand the relevance of **ONLINE IDENTITY, PRIVACY, AND REPUTATION MANAGEMENT**? Module 5 offers a fresh approach to social media that delves into concepts while also providing practical how-to tips.

NEW IMAGING TECHNOLOGIES. In an increasingly visual world, graphical imaging is becoming ever more sophisticated. Module 1 is packed with new information about 360-degree video, stereoscopic graphics, and spherical imaging popularized by **GOPRO CAMERAS, YOUTUBE 360, POKEMON GO, AND GOOGLE CARDBOARD**.

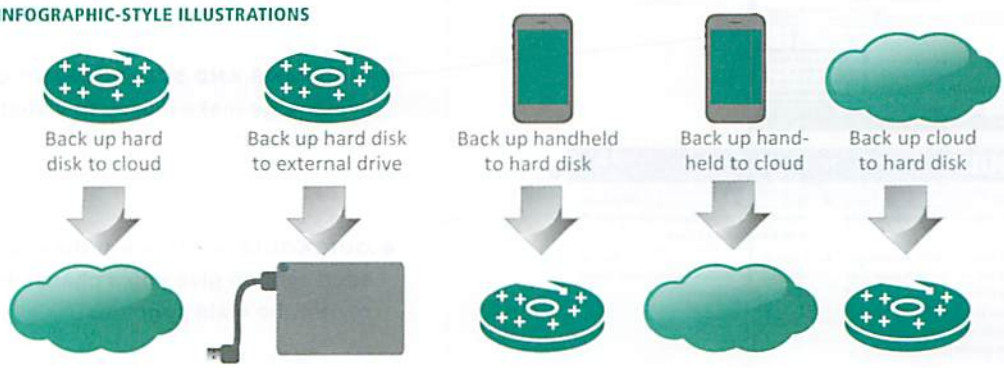
NEW SECURITY ISSUE. Module 7 contains a new Issue, **HOW SECURE IS DEMOCRACY?**, that explores the challenges required to secure voting machines, voter registration data, campaign Web sites, campaign email messages, fund-raising bank accounts, lists of campaign workers, and donor databases.

THE LATEST TECHNOLOGY. Digital technology evolves at a fast pace. NP2018 keeps students up to date with **RASPBERRY PI**, 3D printers, smart appliances, lightning ports, USB-C, accelerometers, gyro sensors, magnetometers, macOS, **WINDOWS 10**, virtual reality headsets, Microsoft Edge, hypervisors, **TWO-FACTOR AUTHENTICATION**, Locky ransomware, and more!

HANDS-ON PROGRAMMING MODULE. Programming with Python provides highly interactive programming activities that **INTRODUCE STUDENTS TO THE WORLD OF PROGRAMMING** without requiring any prior experience. Python is an easy-to-learn language that supports procedural and object-oriented programs.

INFOGRAPHIC ILLUSTRATIONS. Illustrations based on popular infographic visuals are carefully integrated into the learning path to provide **VISUAL SCAFFOLDING** that is so important to understanding technical concepts.

INFOGRAPHIC-STYLE ILLUSTRATIONS



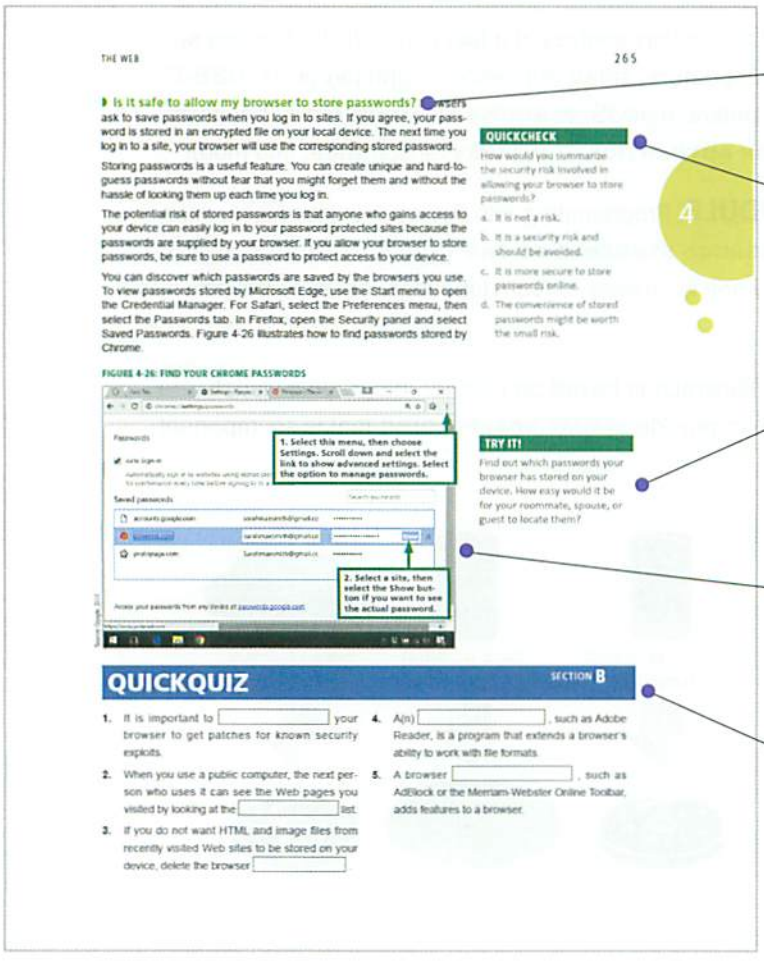
Student Resources: The Book

WHETHER YOU USE THE PRINTED BOOK OR DIGITAL VERSIONS, NP2018 GIVES YOU THE STRAIGHT STORY ON TODAY'S TECHNOLOGY.

EASY TO READ. Each module is divided into five **SECTIONS**, beginning with a **CONCEPT MAP** that provides a visual overview of topics. **FAQs** answer commonly asked questions about technology and help you follow the flow of the presentation.

KEEPS YOU ON TRACK. As you read each page, watch for **QUICKCHECKS**. They'll help you gauge if you comprehend key concepts. And take some time to complete the **TRY IT! ACTIVITIES**. They bring concepts to the real world and help you hone your digital skills. **QUICKQUIZZES** at the end of each section provide a chance to find out if you remember the most important concepts. **END-OF-MODULE REVIEW** activities such as Key Terms, Interactive Situation Questions, and Interactive Summary Questions are great for test prep.

HELPS YOU EXPLORE. The **ISSUE** section in each module highlights controversial aspects of technology. In the **TECHNOLOGY IN CONTEXT** section, you'll discover how technology plays a role in careers such as film-making, architecture, banking, and fashion design. The **INFORMATION TOOLS** section helps you sharpen your digital research techniques. Check out the **LABS** at the end of each module for some step-by-step exploration into your digital devices.



THE WEB 265

Is it safe to allow my browser to store passwords? Users ask to save passwords when you log in to sites. If you agree, your password is stored in an encrypted file on your local device. The next time you log in to a site, your browser will use the corresponding stored password.

Storing passwords is a useful feature. You can create unique and hard-to-guess passwords without fear that you might forget them and without the hassle of looking them up each time you log in.

The potential risk of stored passwords is that anyone who gains access to your device can easily log in to your password protected sites because the passwords are supplied by your browser. If you allow your browser to store passwords, be sure to use a password to protect access to your device.

You can discover which passwords are saved by the browsers you use. To view passwords stored by Microsoft Edge, use the Start menu to open the Credential Manager. For Safari, select the Preferences menu, then select the Passwords tab. In Firefox, open the Security panel and select Saved Passwords. Figure 4-26 illustrates how to find passwords stored by Chrome.

QUICKCHECK

How would you summarize the security risk involved in allowing your browser to store passwords?

a. It is not a risk.
b. It is a security risk and should be avoided.
c. It is more secure to store passwords online.
d. The convenience of stored passwords might be worth the small risk.

4

FIGURE 4-26: FIND YOUR CHROME PASSWORDS

1. Select this menu, then choose Settings. Scroll down and select the link to show advanced settings. Select the option to manage passwords.

2. Select a site, then select the Show button if you want to see the actual password.

TRY IT!

Find out which passwords your browser has stored on your device. How easy would it be for your roommate, spouse, or guest to locate them?

QUICKQUIZ SECTION B

1. It is important to [ ] your browser to get patches for known security exploits.
2. When you use a public computer, the next person who uses it can see the Web pages you visited by looking at the [ ] list.
3. If you do not want HTML and image files from recently visited Web sites to be stored on your device, delete the browser [ ].
4. A(n) [ ], such as Adobe Reader, is a program that extends a browser's ability to work with file formats.
5. A browser [ ], such as AdBlock or the Merriam-Webster Online Toolbar, adds features to a browser.

FAQs break down concepts into manageable chunks of information.

QUICKCHECK questions embedded throughout the module keep learning interactive. Answers are at the end of the book.

TRY IT! ACTIVITIES show how to apply concepts to the real world and help hone your digital skills.

DIAGRAMS AND SCREENSHOTS on every page make it easy to visualize concepts.

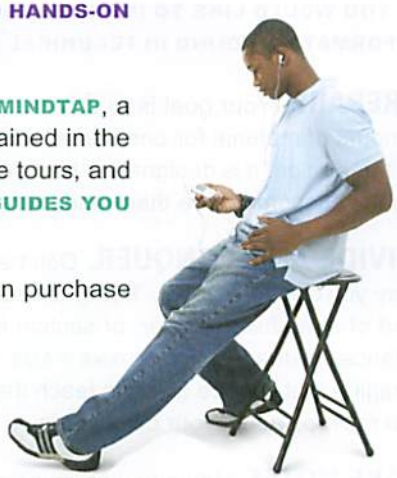
QUICKQUIZ questions at the end of each section give you a chance to review the main concepts.

Student Resources: NP2018 Online

DIGITAL VERSIONS OF YOUR TEXTBOOK INCLUDE MULTIMEDIA AND HANDS-ON ACTIVITIES DESIGNED TO ENHANCE YOUR LEARNING EXPERIENCE.

NP2018 MINDTAP. The digital version of NP2018 is available in **MINDTAP**, a personalized online learning platform. In addition to the full text contained in the printed book, the digital NP2018 includes videos, animations, software tours, and activities based on a learning path designed by your instructor that **GUIDES YOU THROUGH THE COURSE**.

MindTap is a cost-effective alternative to a printed textbook. You can purchase access to NP2018 MindTap from *www.cengagebrain.com*.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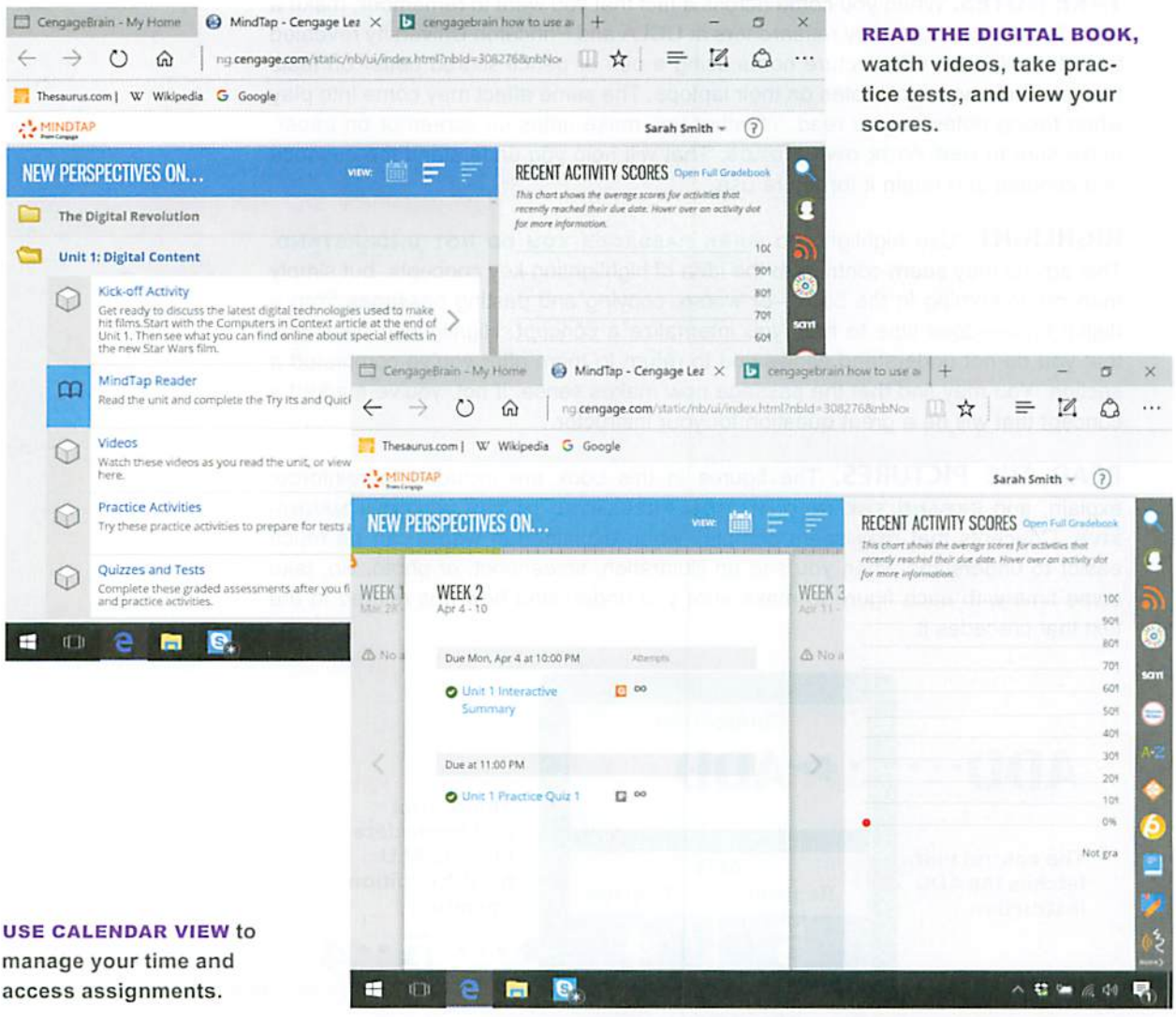


READ THE DIGITAL BOOK, watch videos, take practice tests, and view your scores.

USE CALENDAR VIEW to manage your time and access assignments.

Student Resources: Hone Your Technical Reading Skills

IF YOU WOULD LIKE TO IMPROVE THE WAY YOU COMPREHEND AND RETAIN THE INFORMATION FOUND IN TECHNICAL BOOKS AND DOCUMENTATION, READ ON.

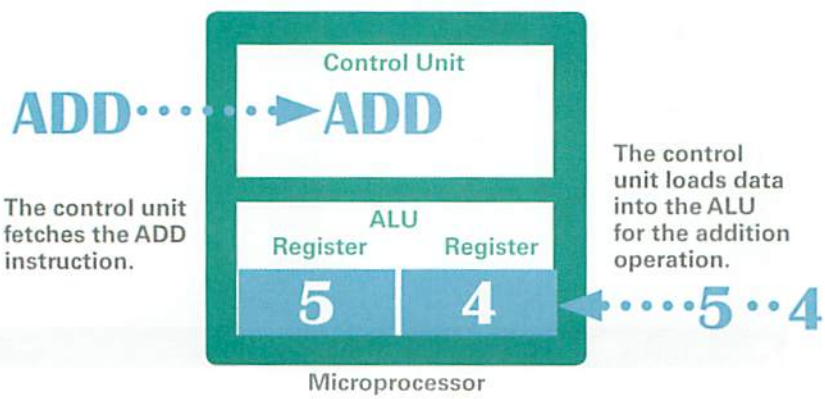
PREPARE. Your goal is to complete one section of a module. That's a sufficient amount of material for one session. **LOOK AT THE CONCEPT MAP** at the beginning of the section. It is designed to help you connect concepts in a web of relationships, so they become more than random facts.

DIVIDE AND CONQUER. Don't expect to read technical material in the same way you'd read a novel. Trying to read without stopping from the beginning to the end of a module, chapter, or section is likely to produce more confusion than confidence. Instead, **TAKE IT ONE PAGE AT A TIME**. Read the page and then pause. Imagine that you are going to teach that material to someone else. Then summarize the main points in your own words.

TAKE NOTES. When you come across a fact that you want to remember, make a note. A study conducted by researchers at UCLA and Princeton University revealed that students who take lecture notes using a pen or pencil scored better on tests than students who took notes on their laptops. The same effect may come into play when taking notes as you read. Whether you make notes on screen or on paper, make sure to **USE YOUR OWN WORDS**. That will help you understand the essence of a concept and retain it for future use.

HIGHLIGHT. Use highlights to **MARK PASSAGES YOU DO NOT UNDERSTAND**. This advice may seem contrary to the idea of highlighting key concepts, but simply marking something in the book—or worse, copying and pasting passages from a digital book—does little to help you internalize a concept. Highlighting passages that you do not understand allows you to return to them after you've completed a section. You may find that the passage now makes sense. If not, you've marked a concept that will be a great question for your instructor.

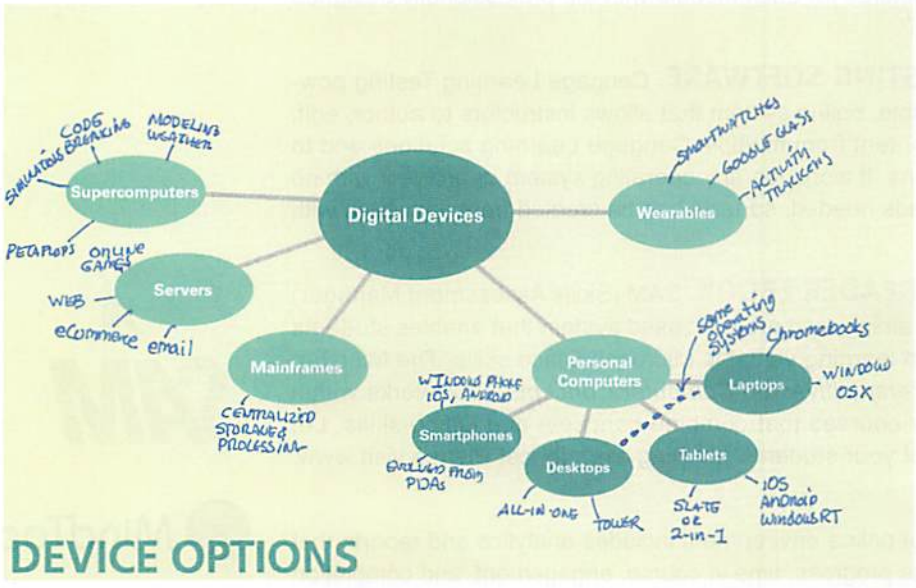
READ THE PICTURES. The figures in this book are included to reinforce, explain, and **EXPAND THE INFORMATION PRESENTED IN THE WRITTEN NARRATIVE**. Concepts that may seem complex when explained in words can be much easier to understand when you see an illustration, screenshot, or photo. So, take some time with each figure to make sure you understand how it is related to the text that precedes it.



TEST YOURSELF. Researchers at Purdue University discovered that "practicing retrieval" through self-testing is one of the **MOST EFFECTIVE TECHNIQUES FOR LEARNING**. NP2018 supplies you with lots of opportunities to retrieve material. Make sure to use the QuickChecks, QuickQuizzes, Interactive Summaries, and Interactive Situation Questions. Additional resources, such as flashcards and module quizzes, are available with the NP2018 MindTap.

BE AN ACTIVE LEARNER. The concepts in NP2018 are not abstract theories. Most have practical applications for today's digital lifestyles. You'll find that concepts are much easier to remember if you can apply them and understand how they are relevant. The **TRY IT! ACTIVITIES** throughout every module show you how to apply concepts. The best learning strategy is to complete these activities as you encounter them. They'll give you a break from reading and help you to understand how all the practical and conceptual pieces fit together.

GET THE CONNECTIONS. The bubble diagrams supplied at the beginning of each section provide an overview of concepts and their linkages. After reading a section, you might want to **EXTEND THE CONCEPT MAPS** by adding more details. You can add another level of concepts. Also, think of additional relationships between the existing concepts and mark them with dotted lines.



CORRECTIONS. Despite intensive attention to quality, occasional typos and other errata slip into the book. Corrections are posted to your student companion site, which you can access by logging in to your account at *login.cengage.com*.

Instructor Resources

NP2018 RESOURCES PROVIDE INSTRUCTORS WITH A WIDE RANGE OF TOOLS THAT ENHANCE TEACHING AND LEARNING. THESE RESOURCES AND MORE CAN BE ACCESSED FROM THE NP2018 INSTRUCTOR COMPANION SITE. LOG IN AT WWW.CENGAGEBRAIN.COM.

INSTRUCTOR'S MANUAL. The NP2018 Instructor's Manual offers the following comprehensive instructional materials:

- Module objectives and key terms
- Bullet-point lecture notes for each module section
- Classroom activities and teaching tips

SOLUTION FILES. Your password-protected instructor resources provide answers to all the QuickChecks, Lab Assignments, Interactive Summaries, Interactive Situation Questions, Issue Try It! activities, and Information Tools Try It! activities.

TABBING GUIDE. If you've used previous editions of *New Perspectives on Computer Concepts*, you'll appreciate the Tabbing Guide that lets you see at a glance what's been updated for this edition. Use it to make revisions to your syllabus, as necessary.

FLEXIBLE POWERPOINTS. Instructors can customize and deliver engaging and visually impressive lectures for each module with the professionally designed PowerPoint slides.

TESTBANKS AND TESTING SOFTWARE. Cengage Learning Testing powered by Cognero is a flexible, online system that allows instructors to author, edit, and manage test bank content from multiple Cengage Learning solutions and to create multiple test versions. It works on any operating system or browser with no special installs or downloads needed, so tests can be created from anywhere with Internet access.

SAM AND MINDTAP READER EBOOK. SAM (Skills Assessment Manager) is a robust assessment, training, and project-based system that enables students to be active participants in learning valuable Microsoft Office skills. The MindTap Reader version of *New Perspectives on Computer Concepts 2018* works within the SAM environment for courses that combine concepts and Office skills. Let SAM be an integral part of your students' learning experience! Please visit *www.cengage.com/sam*.

MINDTAP. This powerful online environment includes analytics and reports that provide a snapshot of class progress, time in course, engagement, and completion rates.

FROM THE AUTHOR

So much has changed since the first edition of Computer Concepts was published in 1994! From year to year, the changes have been subtle, but looking back, it is clear that technology, students, and even education has progressed in amazing and sometimes unexpected directions. As digital technology continues to evolve, New Perspectives continues to keep pace, providing students with up-to-date content and cognitive tools that engage and ensure successful learning outcomes.

Many of today's students have substantially more practical experience with digital devices than their counterparts of twenty years ago, but even these students may lack a cohesive framework for their knowledge.

The goal of *New Perspectives on Computer Concepts* is to bring every student up to speed with computer basics, and then go beyond basic computer literacy to provide students with technical and practical information that every college-educated person would be expected to know.

Whether you are an instructor or a student, we hope that you enjoy the learning experience provided by our text-based and technology-based materials.

ACKNOWLEDGEMENTS

The book would not exist—and certainly wouldn't arrive on schedule—were it not for the efforts of our media, editorial, and production teams. Grateful thanks to Kate Russillo for her developmental edit and tireless work on every detail of the project; Kathleen McMahon and Amanda Lyons-Li for their executive leadership of the New Perspectives series; Abigail Pufpaff for quickly getting up to speed on all the dimensions of this project; Sumathy Kumaran and the team at Lumina for managing production; Stacey Lamodi for managing the day-to-day schedule; and our brilliant sales reps for encouraging instructors to adopt this book to enhance their introductory courses.

The MediaTechnics team worked tirelessly and deserve a round of applause. Thank you to Tensi Parsons for her extraordinary devotion to desktop publishing and infographic design; Keefe Crowley for his versatile skills in creating videos, taking photos, and compiling test banks; and Chris Robbert for his clear narrations. Dan Oja is our technical guru and digital education visionary; his pioneering efforts to create the first online testing system and interactive digital textbook set a high standard for today's developers.

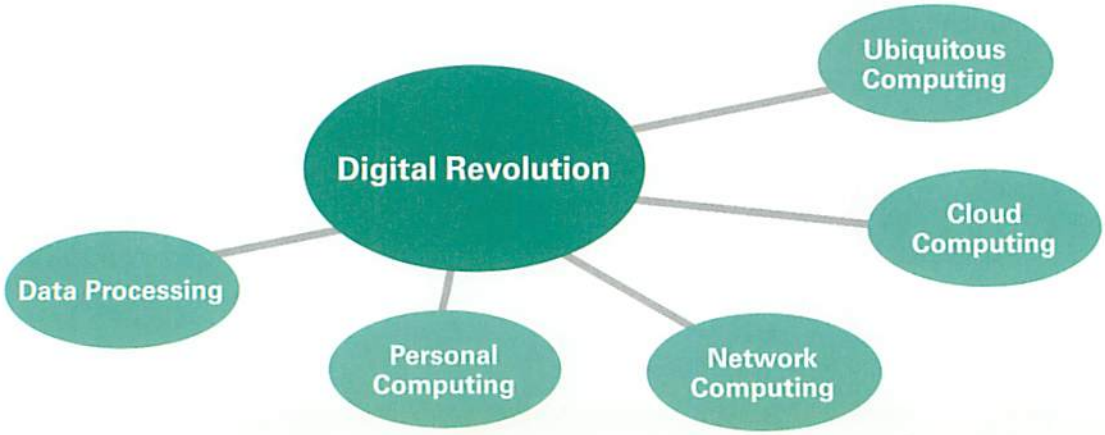
A special shout-out in this edition goes to my father, John X. Jamrich, who as a lifelong educator and president of Northern Michigan University showed me the value of helping students achieve their goals through education.

Additional acknowledgements go to the New Perspectives Advisory Committee members, reviewers, and students who have made a tremendous contribution to every edition of Computer Concepts. Thank you all!

June Jamrich Parsons

NEW PERSPECTIVES

Computer Concepts 2018



INTRODUCTION

WE LIVE IN THE INFORMATION AGE: a period in history when information is easy to access and affects many aspects of everyday life, from the economy to politics and social relationships. The importance of information is not new. It has always been a powerful tool. Scrolls treasured by monks during the Middle Ages, scientific knowledge collected during the Renaissance, and intelligence data collected during the Cold War were all critical in shaping world events. The Information Age is unique because of its underlying technology based on digital electronics. This introduction offers an overview of the digital revolution that continues to reinvent the Information Age.

Terminology

digital revolution digital **digital content** **user interface** computer terminal **centralized computing** data processing **personal computing** local software **computer network** Internet Web cloud computing **convergence** Web 2.0 **social media** sharing economy **ubiquitous computing** virtual reality **augmented reality** Internet of Things **autonomous vehicles**

Objectives

- Name the five phases of the digital revolution and place each on a timeline.
- Describe the digital devices that were popular during each phase of the digital revolution.
- List at least five characteristics of each phase of the digital revolution.
- Find two similarities and two differences between technology in the data processing era and technology in the cloud computing era.
- Evaluate the strengths and weaknesses of today's digital environment.
- Distinguish between virtual reality and augmented reality.
- Consider the tradeoffs we make when living in a digital society.

THE DIGITAL REVOLUTION

The **digital revolution** is an ongoing process of social, political, and economic change brought about by digital technology, such as microchips, computers, and the Internet.

What is digital? **Digital** is a type of technology that represents written, visual, audio, and quantitative data as numbers, such as 1s and 0s. The word *digital* comes from the root *digit*. In the language of mathematics, a digit is the symbol used to write the numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

Like the agricultural revolution and the industrial revolution, the digital revolution offers advantages but requires adaptations. Digital innovations challenge the status quo and require societies to make adjustments to traditions, lifestyles, and legislation.

Digital devices were originally called *computer hardware* or *computing machines*. The programs and data they contain were referred to as *computer software*. Today, software is commonly referred to as *apps*.

The technology driving the digital revolution is based on digital electronics and the idea that electrical signals can represent data, such as numbers, words, pictures, and music. We often call this data **digital content**.

What is the significance of digital content? An interesting characteristic of digital content is that it can be easily duplicated with no loss of quality. Before digital technology, photocopies of paper documents usually looked blurred. Copying a movie on tape reduced its quality, and every subsequent copy became progressively worse. Now, digital copies are essentially indistinguishable from originals, which has created new possibilities for content distribution on platforms such as iTunes and Netflix.

Digital devices, including computers and smartphones, transformed our world. Without them, your favorite form of entertainment would probably be foosball, and you'd be listening to a bulky old Victrola instead of carrying a sleek iPod (Figure 1).

FIGURE 1: IS MUSIC CHEAPER TODAY?

1922

For $1.00, you could purchase a record containing two songs.

That's **$14.11** in today's money.

2018

On iTunes, one song costs $1.29.

Two songs cost only **$2.58** today.

TRY IT!

Music is clearly less expensive today than it was back in 1922, but what about books? Can you find the price of a book during the 1920s and the price of an equivalent Kindle book today? Don't forget to convert the cost into today's dollars. (Search online for *inflation calculator*.)

DATA PROCESSING

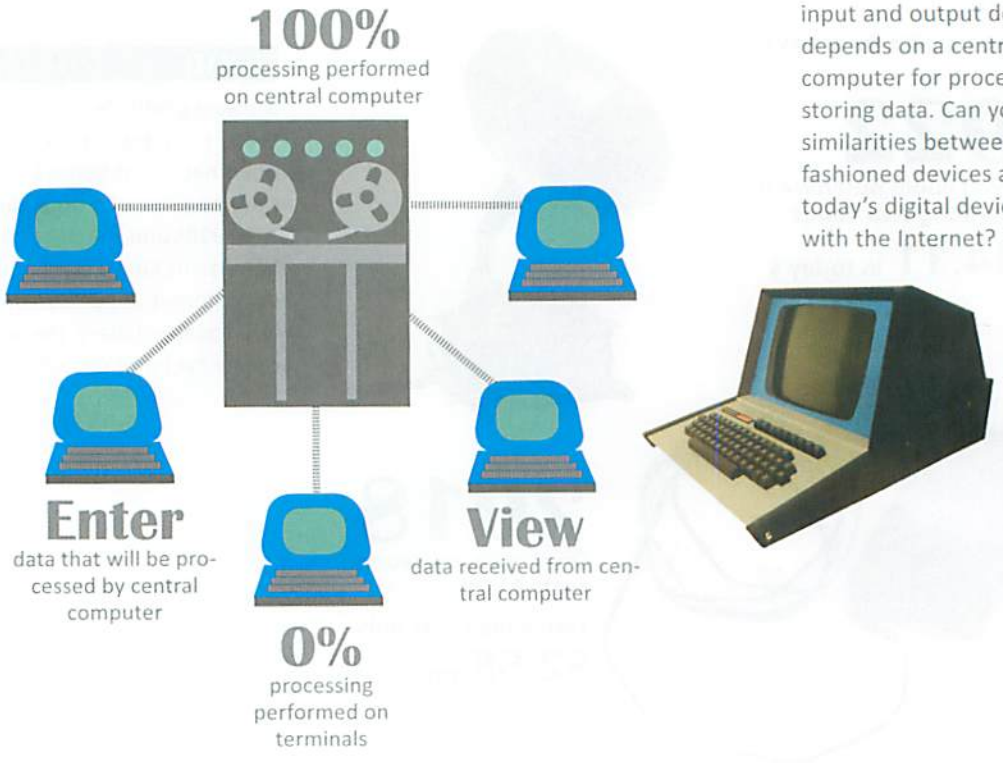
Some historians mark the 1980s as the beginning of the digital revolution, but engineers built the first digital computers during World War II for breaking codes and calculating missile trajectories. In the 1950s, computers were marketed for business applications, such as payroll and inventory management.

What was computing like back then? In the first phase of the digital revolution, computers were huge, complex, and expensive devices that stored data on reels of magnetic tape. They existed in limited numbers, primarily housed in big corporations and government agencies. Computers were operated by trained technicians. Each computer installation required specialized software. The idea that computers might be used by ordinary people in their homes was only a glimmer of an idea in the minds of science fiction writers.

One drawback to computer use was the **user interface**, the mechanism for entering and viewing data. Back then, processing components for computers were housed in closet-sized cabinets. The main computer unit was separate from the devices used for input and output. Initially, data was entered on punched cards and results were printed on continuous form paper. Later, computers were accessed using the keyboard and display screen of a terminal. A **computer terminal** has little processing capability of its own, so it was simply used to enter data and view results produced by software that ran on the main computer (Figure 2).

This method of computing, in which a main computer holds all of the data and performs all of the processing, is called **centralized computing**. It was the main technology model used during the data processing era. Devices such as terminals and printers were connected to a centralized computer with cables, as shown in Figure 2.

FIGURE 2: CENTRALIZED COMPUTING



QUICKCHECK

Data processing was characterized by _____.

a. centralized computing

b. primitive digital devices such as calculators and watches

c. standalone computers such as Apple IIs and IBM PCs

d. local software and data storage

TRY IT!

A computer terminal, like the one shown below, is an input and output device that depends on a centralized "host" computer for processing and storing data. Can you identify similarities between these old-fashioned devices and the way today's digital devices interact with the Internet?

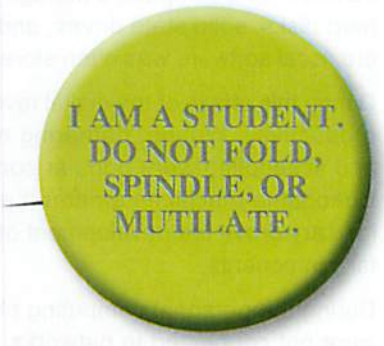
Who had access to computers? During the antiestablishment era of the 1960s, the digital revolution was beginning to transform organizations, but ordinary people had little direct contact with computers.

As with many new technologies, computers were initially viewed with suspicion by consumers. IBM's corporate slogan "THINK" conveyed to some people a disturbing image of giant machine "brains."

Computers seemed remote. They were housed out of sight in special facilities and were inaccessible to ordinary people. Computers also seemed impersonal. To uniquely identify people, computers used sequences of numbers such as Social Security numbers. The fact that computers tracked people by numbers, rather than by their names, alienated many students and workers.

In the 1960s, computers and punched cards became a symbol of the establishment. Students were uncomfortable with the use of punched cards for storing academic records (Figure 3). The leader of a protest on the University of California, Berkeley campus complained, "You're processed. You become a number on a set of file cards that go through an IBM machine."

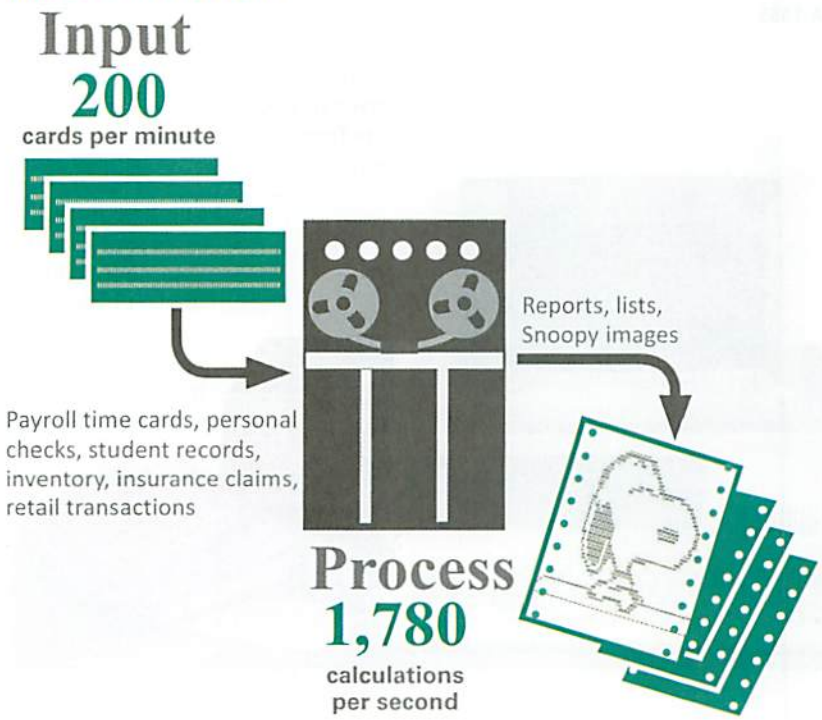
FIGURE 3: ANTIESTABLISHMENT
In the 1950s and 1960s, data used by government and business computers was coded onto punched cards that contained the warning "Do not fold, tear, or mutilate this card." Similar slogans were used by protesters who were concerned that computers would have a dehumanizing effect on society.



What is data processing? Throughout the first phase of the digital revolution, businesses adopted computers with increasing enthusiasm based on benefits such as cutting costs and managing mountains of data. Computers and data processing became crucial tools for effective business operations. **Data processing** is based on an input-processing-output cycle. Data goes into a computer, it is processed, and then it is output (Figure 4).

The data processing era lasted from the 1940s through the 1970s. Data processing installations still exist today, but other technologies emerged, making computing available to a more diverse group of users.

FIGURE 4: DATA PROCESSING



TRY IT!

Have you seen the classic film *Desk Set* starring Spencer Tracy and Katharine Hepburn? It characterizes the public's attitude toward computers in the 1950s. Look for it on Netflix or Amazon Prime. What do you think caused such widespread technophobia?

PERSONAL COMPUTING

Digital devices were first available to consumers in the 1970s, when handheld calculators and digital watches hit store shelves. The first personal computers made their debut in 1976, but sales got off to a slow start. Without compelling software applications, personal computers, such as the Apple II and IBM PC, seemed to offer little for their $3,000 price tag. As the variety of software increased, however, consumer interest grew.

What is personal computing? The second phase of the digital revolution, **personal computing**, is characterized by standalone computers powered by local software. **Local software** refers to any software that is installed on a computer's storage device. Today, local software resides on hard disks, solid state drives, and flash drives. In the personal computing era, local software was often stored on floppy disks.

During this phase of the digital revolution, computers were used to enhance productivity. Writing, gathering numbers into easily understood charts, and scheduling were popular computer-based activities. Computers and videogame machines emerged as entertainment devices, and the game industry drove the development of ever faster and more sophisticated digital components.

During the personal computing phase of the digital revolution, computers were not connected to networks, so they were essentially self-contained units that allowed users to interact only with installed software. On the business front, centralized computer systems continued to run payroll, inventory, and financial software. Some managers used personal computers and spreadsheet software to crunch numbers for business planning.

If you had owned a computer back in the second phase of the digital revolution, it was probably a standalone machine with primitive sound capabilities. The display device looked like an old-fashioned television (Figure 5).

QUICKCHECK

Personal computing was characterized by _____.

a. software housed on a centralized computer

b. sophisticated software applications

c. storing data in the cloud

d. local software and data storage

TRY IT!

Imagine that there is no Internet. Take a look at your computer and make a quick list of programs that you'd be able to use in a world without the Internet.

FIGURE 5: PERSONAL COMPUTING CIRCA 1985

How extensive was computer use? In contrast to the corporate focus of the data processing phase, personal computing promised to put the power of digital devices in the hands of ordinary people. Computers were no longer a symbol of the corporate establishment. As a new generation of computing devices evolved, IBM's "THINK" slogan was upstaged by Apple's message: "Think Different."

The promise of populist computing, however, was not backed up with compelling reasons to invest in a computer. In 1982, fewer than 10% of U.S. households had a computer. Working on a standalone computer wasn't for everyone. People without an interest in typing up corporate reports or school papers, crunching numbers for accounting, or playing computer games weren't tempted to become active soldiers in the digital revolution.

Social scientists even worried that if personal computing became widespread, people would become increasingly isolated as they focused on computer activities rather than social ones. Although rudimentary email systems existed on centralized corporate computer systems, home computers were not connected, so there was no way to transmit email messages.

How long was the second phase of the digital revolution? Computer ownership increased at a gradual pace until the mid-1990s, and then it accelerated into the third phase of the digital revolution (Figure 6).

QUICKCHECK

What problem arising from personal computing worried social scientists?

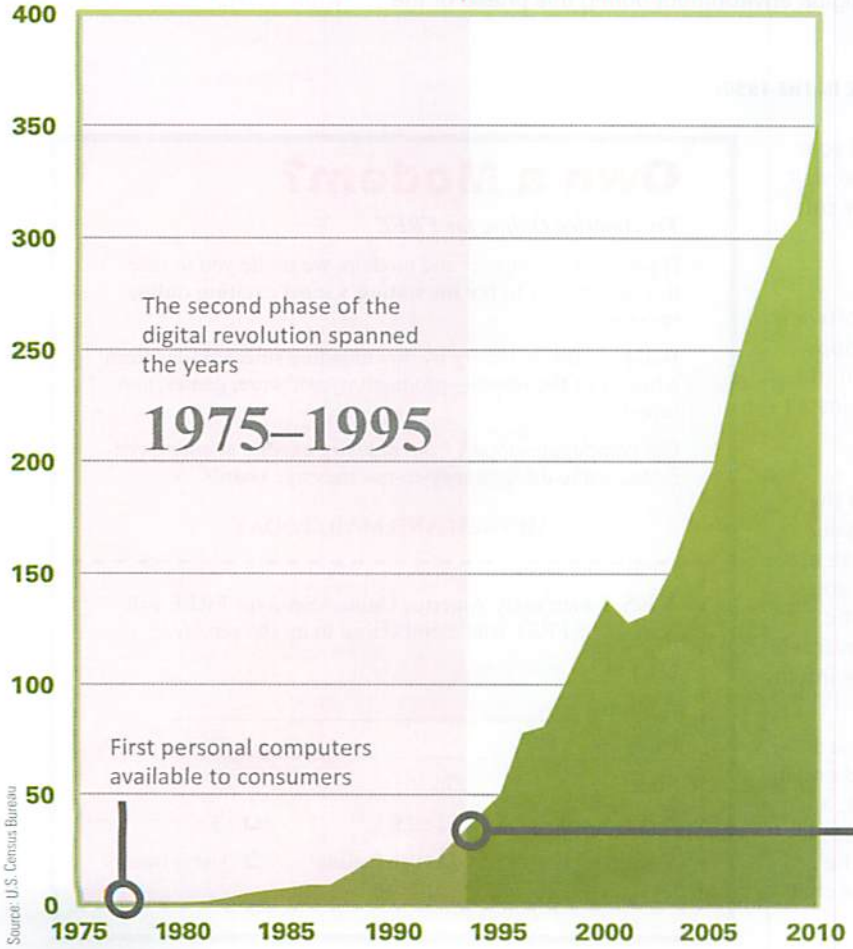
a. Big corporations spying on customer behavior

b. Increasing isolation as people spent more and more time using a computer

c. Privacy

d. Piracy

FIGURE 6: PERSONAL COMPUTER OWNERSHIP (MILLIONS OF HOUSEHOLDS)



QUICKCHECK

During the second phase of the digital revolution, which one of the following was making news headlines?

a. A new band called The Beatles

b. The first space flights

c. Think Different

d. WikiLeaks

NETWORK COMPUTING

The third phase of the digital revolution materialized as computers became networked and when the Internet was opened to public use. A **computer network** is a group of computers linked together to share data and resources.

What kinds of networks were available? Network technology existed before the Internet became popular, but these networks were mainly deployed to connect computers within a school or business. For the most part, these networks connected devices using cables; wireless networks were not available.

During this era, networks were complicated to set up and they were often unreliable. Before the Internet opened to public use, online services such as CompuServe and America Online operated centralized computer networks that could be accessed by the public from dial-up modems.

What role did the Internet play? The **Internet** is a global computer network that was originally developed as a military project and was later handed over to the National Science Foundation for research and academic use. When restrictions on commercial use of the Internet were lifted in the early 1990s, newly emerged ISPs offered fee-based Internet access. America Online, CompuServe, and other online services expanded to offer Internet-based chat and Web access. Excerpts from the AOL ad in Figure 7 may help you to appreciate the digital environment during this phase of the digital revolution.

TRY IT!

Internet connections were initially made over telephone lines with a device called an acoustic modem. You'll be surprised to see how these modems work. Search for a photo of one online. Could you use this type of modem with your smartphone?

FIGURE 7: USING AN ONLINE SERVICE IN THE 1990s

Step 1: Mail in your application and wait to receive your software.

Step 2: Your software arrives on a floppy disk. Insert it in the disk drive and install it.

Step 3: Fire up the software and your modem to make a connection. If you have an acoustic modem, put your telephone handset into it.

Step 4: Download software, send email, post messages, and mingle with people from all over the world in online chat rooms.

Own a Modem?

Try America Online for FREE

If you own a computer and modem, we invite you to take this opportunity to **try the nation's most exciting online service**.

Build a software library by downloading selected files from a library of thousands—productivity software, games, and more!

Get computing support from industry experts at online conferences and through easy-to-use message boards.

DETACH AND MAIL TODAY

YES, I want to try America Online! Send me FREE software and a FREE trial membership to try the service.

Name: _____

Address: _____

City: _____

State: _____ Zip: _____

Disk type and size: ❑ 5.25 ❑ 3.5

❑ High Density ❑ Double Density

Source: *Wired*, May 1993

What about the Web? When historians look back on the digital revolution, they are certain to identify the Web as a major transformative influence. The **Web** (short for *World Wide Web*) is a collection of linked documents, graphics, and audio that can be accessed over the Internet.

A key aspect of the Web is that it adds content and substance to the Internet. Without the Web, the Internet would be like a library without any books or a railroad without any trains. Online storefronts, auction sites, news, sports, travel reservations, and music downloads made the Web a compelling digital technology for just about everyone.

So what was computing like during this phase? From 1995 to 2010, computing was characterized by the increasing use of laptops (Figure 8) and the following elements:

Sophisticated software. The network computing phase may have been the peak for productivity software. Computer owners amassed large collections of software, purchased in boxes containing multiple distribution CDs. Software such as Microsoft Office, Norton's Internet Security suite, and Corel Digital Studio required local installation and provided more features than most people had any desire to use. This trend reverses during the next phase of the digital revolution, when applications become simpler and more focused on specific tasks.

Stationary Internet access. Even as laptop computers began to displace desktop models, connecting to the Internet required a cable that effectively tethered computers to a nearby phone jack or cable outlet. In the next phase of the digital revolution, Internet access breaks free from cables and goes mobile.

Online communication. Email was the first widespread technology used to communicate over the Internet. Online services such as CompuServe and AOL pioneered chat rooms, which were primitive versions of Google Hangouts. Early forums and message boards were similar to Facebook timelines. A technology called Voice over IP allowed participants to bypass the telephone company to make phone calls over the Internet. That technology eventually developed into Skype and similar video chat services.

Multiplayer games. Sophisticated computer games reached a peak during the network phase of the digital revolution. Audio and visual hardware components improved to support video-realistic game environments, artificial intelligence opponents, and multiple players logging in remotely and chatting with other players over headsets. In the next phase, mobile devices become popular gaming platforms, but hardware limitations restrict the feature set.

Music downloads. During the network computing phase, an online business called Napster pioneered the concept of sharing and downloading music. Subscribers exchanged millions of music files, which they played through the speakers of their computers. The music was protected by copyright, however, making sharing and distribution illegal. This type of file sharing activity and rampant software piracy became one of the defining problems associated with the network phase of the digital revolution.

iTunes and other services for legally downloading music soon appeared, along with dedicated playback devices, such as the iPod. Video distribution over the Internet lagged behind until connection speeds increased in the next phase of the digital revolution.

QUICKCHECK

The Web and the Internet are not the same. Why?

a. The Internet is a communication network, but the Web consists of content that is distributed by the Internet.

b. The Internet consists of sites such as Twitter and Facebook, whereas the Web links devices such as iPods and computers.

FIGURE 8: LAPTOPS
Laptop computers were the primary devices for accessing the Internet prior to 2010. User interfaces evolved to include color, graphics, and mice.

CLOUD COMPUTING

Around 2010, the Information Age eased into a new phase called **cloud computing**, which provided access to information, applications, communications, and storage over the Internet.

What did cloud computing change? Before cloud computing, most computers ran software based locally. For example, to use a word processor, you might fire up the latest edition of Microsoft Word, which you'd installed on your computer's hard disk. Prior to the cloud, you stored data locally, too. Email, documents, photos, and music all resided on your computer's hard disk or flash drive.

With cloud computing, all that changed. In the cloud, you can use your browser to access word processing applications that run from the Internet instead of software that you have installed on your local hard disk. You can use online applications to manage your email, create floor plans, produce presentations, and carry out a host of other activities. You can store your data in the cloud, too, making it available on any of your digital devices that connect to the Internet.

The cloud gets its name from diagrams like the one in Figure 9, which shows Internet-based applications, storage, and other services outlined by a cloud-like shape designed to help you visualize the idea that cloud services are "out there" somewhere on the Internet.

QUICKCHECK

Which characteristic of cloud computing most sets it apart from network computing?

a. Internet access

b. Sophisticated software

c. The migration of applications and data off of local devices

d. File sharing

FIGURE 9: THE CLOUD HOSTS APPLICATIONS, CONTENT, AND SERVICES

Wait, this sounds familiar! If cloud computing sounds a bit like centralized computing, you're paying attention. The concept of applications and data residing somewhere other than on a local device is common to both centralized and cloud computing. The cloud concept reawakens the idea of monolithic computing facilities, as opposed to distributed architectures of the network era. The fact that your cloud-based data is not stored on devices under your direct control is a potential privacy and security concern, which is a topic for later modules.

Are smartphones the signature device of the cloud computing era? The cloud itself is populated by commercial-grade high-speed computers and high-capacity storage devices. The consumer side is dominated by smartphones (Figure 10) and their close cousins, tablet computers. These handheld devices—a product of convergence—were the driving force for many cloud innovations.

What is convergence? The expansion of cloud computing is due in part to **convergence**, a process by which several technologies with distinct functionalities evolve to form a single product. Convergence was important to the digital revolution because it created sophisticated mobile devices whose owners demanded access to the same services available from a full-size desktop computer. Those services became available in the cloud.

Your computer plays movies. Your cell phone has a camera. Your clock has a radio. Your watch functions as a communications device. You can store data on your iPod Touch. All these are examples of technological convergence.

Convergence worked its magic on cell phones, computers, portable media players, televisions, digital cameras, GPSs, watches, and ebook readers. Now you get features from all of them by purchasing a single digital device, such as a smartphone or tablet computer (Figure 11).

FIGURE 10: SMARTPHONES
Cloud computing caters to smartphones and other mobile devices that are a product of convergence. They access and share data from the cloud using apps.

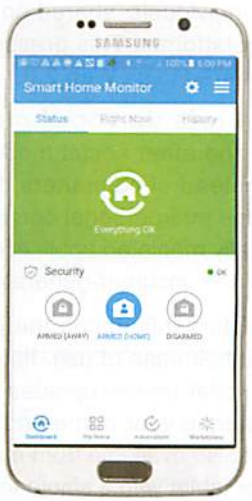
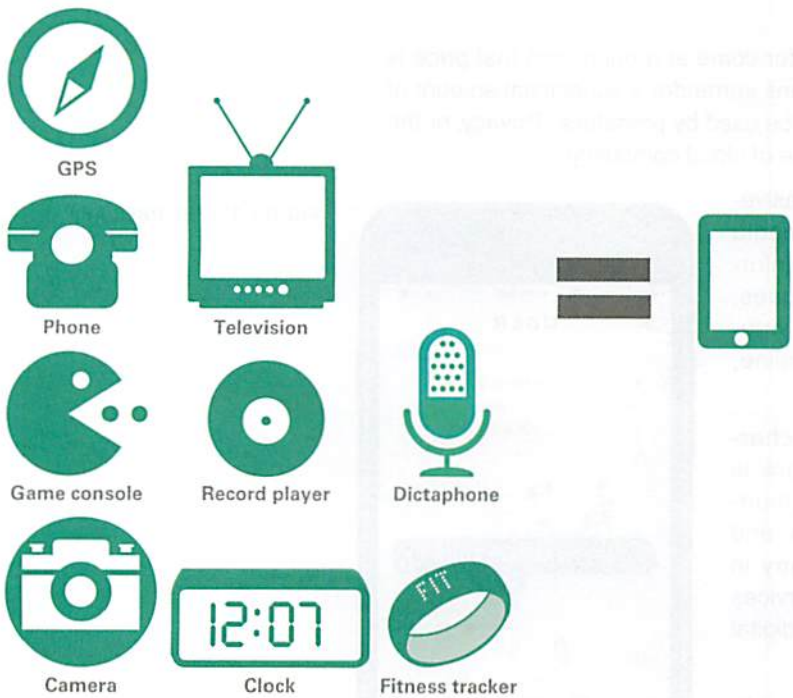


FIGURE 11: SMARTPHONES ARE A PRIME EXAMPLE OF CONVERGENCE



Why do these devices need the cloud? Smartphones are portable. Compared to desktop and laptop computers, smartphones have small screens, lack a proper keyboard, and have limited space for storing apps and data. The cloud offers a convenient place to store data and applications. Think of the cloud as a repository for streaming videos, music, photos, and apps. With that concept in mind, you will begin to understand the cloud's importance to today's consumers.

QUICKCHECK

Which of the following instigated the move to cloud computing?

a. Social media

b. Mobile devices

c. Touchscreens

d. Music downloads

Did the cloud kill the Web? A 2010 *Wired* magazine cover announced "The Web Is Dead." That pronouncement was premature. The cloud consumed the Web but did not kill it. As a legacy technology from the networking era, the Web continues to be a global marketplace where Amazon, Alibaba, and other retailers sell directly to consumers.

That said, Facebook, Twitter, and Google Apps sent the Web in new directions. Once a collection of storefronts run exclusively by businesses and corporations, the Web expanded into a global hub where content was created by individuals, shared on social media sites, and uploaded to content sharing platforms. This grassroots Web of user-created content is sometimes referred to as **Web 2.0**.

What role do social media play in the cloud era? Facebook, Twitter, and other social media turned the worry of social isolation on its head; instead of computers decreasing human interaction, social media encourage interpersonal communications and relationships. **Social media** are digitally mediated applications designed for communication, social interaction, and consumer-generated content.

Many factors influenced the popularity of these sites, but one important factor is their ease of use. Initially offered as Web sites, there was no software to install and no updates to worry about. Getting started was as simple as registering your name and creating a password. Now, access to social media is also available from mobile apps, which can be installed on a smartphone or tablet with a single touch.

The connections that social media offer come at a price, and that price is not just monetary. Today's digital citizens surrender a substantial amount of privacy, exposing information that can be used by predators. Privacy, or the lack of it, may be the defining challenge of cloud computing.

Another challenge is the growing pervasiveness of advertising. Where social media was once a platform for exchanging information between friends and colleagues, intrusive advertising is now found on virtually every Web page, Facebook timeline, and Twitter stream.

Cloud-enabled apps? A key characteristic of the cloud computing era is globe-spanning sharing services. Cloud-based services such as Uber, Airbnb, and Etsy are part of the **sharing economy** in which consumers offer goods and services to other consumers through a shared digital platform.

These sharing services use the cloud to communicate and process data. The apps used by consumers may look simple (Figure 12), but behind the scenes an amazing amount of computer power handles the necessary data and logistics.

TRY IT!

In 2011, the United Nations declared that the Internet "is an indispensable tool for realizing a range of human rights...." Visit the Internet World Stats site to find out what percentage of the world's population has Internet access.

2017 Uber Technologies Inc.

FIGURE 12: THE UBER APP

UBIQUITOUS COMPUTING

As 2020 nears, a new phase of the digital revolution is taking shape. **Ubiquitous computing** is characterized by a focus on manipulating real-world objects instead of data. Earlier computing technologies used data to represent things in the real world. Photos represented people. Maps showed the location of places. Videos gave us a glimpse of events. Screen-based fantasy worlds and characters entertained us. But all of this was conjured from data. None of it was tangible reality.

Virtual reality, augmented reality, the Internet of Things, and automated vehicles are shaping a new digital era in which technologies bring computing beyond the screen and into the world of tangible objects.

What is virtual reality? In the *Star Trek* series, the starship *Enterprise* had a recreational facility called the holodeck. It was actually an empty room, but fictional "hard light" projectors created touchable and temporarily solid objects to replicate indoor and outdoor spaces. The holodeck is a futuristic version of **virtual reality**, the use of technology to create a simulated three-dimensional world.

Today's virtual reality is far from a holodeck, but donning a virtual reality headset can give you the impression that you are in the middle of a three-dimensional environment. You can look up and down and swivel your head to see your surroundings (Figure 13).

Terminology

Ubiquitous computing is sometimes referred to as *pervasive computing*. The idea is not new. In the 1990s, Mark Weiser predicted that computers will "weave themselves into the fabric of everyday life until they are indistinguishable from it."

FIGURE 13: VIRTUAL REALITY SIMULATES THE REAL WORLD

ArtFamily/Shutterstock.com

How is augmented reality different than virtual reality? Instead of creating a simulated world, **augmented reality** superimposes data over the real world. Pokémon GO popularized augmented reality and provides a great example of how it works.

The reality of Pokémon GO is the real world in your vicinity. It can be shown on your smartphone screen as a map or as a pass-through image from the camera. Pokémon characters are superimposed on the landscape and can be seen through the camera lens. The characters are the augmentation (Figure 14).

FIGURE 14: POKÉMON GO IS AUGMENTED REALITY

Matthew Corley/Shutterstock.com