16th Edition
Global Edition

Technology in Action

Complete

Alan Evans • Kendall Martin • Mary Anne Poatsy

Pearson

Contents

Chapter 1

The Impact of Technology in a Changing World 30

Part 1: Technology in Society 32

Learning Outcome 1.1 You will be able to discuss the impact of the tools of modern technology on national and global issues.

Technology in a Global Society 32

Impact of Tools of Modern Technology 32
Objective 1.1 *Describe various technological tools being used to impact national and global issues.*

Global Issues 33
Objective 1.2 *Describe various global social issues that are being affected by technology.*

Technology Connects Us with Others 34

Technology Impacts How and Why We Connect and Collaborate 34
Objective 1.3 *Describe how technology is changing how and why we connect and collaborate with others.*

Technology Impacts How We Consume 35
Objective 1.4 *Summarize how technology has impacted the way we choose and consume products and services.*

The Importance of Computer Literacy 36

Computer Literacy 36
Objective 1.5 *Characterize computer literacy and explain why it is important to be computer literate.*

HELPDESK: Technology Impacts 36

SOUND BYTE: Virtual Computer Tour 37

TRY THIS: What Does Facebook Know about You? 39

MAKE THIS: TOOL: IFTTT.com (If This Then That) 40

Part 2: Emerging Technologies and Ethical Computing 41

Learning Outcome 1.2 You will be able to describe emerging technologies, such as artificial intelligence, and how technology creates new ethical debates.

Artificial Intelligence 41

Artificial Intelligence Basics 41
Objective 1.6 *Describe artificial intelligence systems and explain their main goals.*

HELPDESK: The Impact of Artificial Intelligence 41

ETHICS IN IT: Ethics in Computing 44

Working with Artificial Intelligence and Other Information Technologies 45

Technology and Your Career 45
Objective 1.7 *Describe how artificial intelligence and other emerging technologies are important in many careers.*

BITS&BYTES: Is It AI or Human? Take a Turing Test! 47

DIG DEEPER: XR Extended Reality 49

Ethical Computing 50

Defining Ethics 50
Objective 1.8 *Define ethics and examine various ethical systems.*

SOUND BYTE: How to Debate Ethical Issues 50

Personal Ethics 51
Objective 1.9 *Describe influences on the development of your personal ethics.*

Ethics and Technology 53
Objective 1.10 *Present examples of how technology creates ethical challenges.*

SOLVE THIS: How Technology Is Used on the World Stage and in Your Personal Life 63

Chapter 2

Looking at Computers: Understanding the Parts 64

Part 1: Understanding Digital Components 66

Learning Outcome 2.1 You will be able to describe the devices that make up a computer system.

Understanding Your Computer 66

Computers Are Data Processing Devices 66
Objective 2.1 *Describe the four main functions of a computer system and how they interact with data and information.*

Binary: The Language of Computers 67
Objective 2.2 *Define bits and bytes, and describe how they are measured, used, and processed.*

SOUND BYTE: Binary Numbers Interactive 67

Types of Computers 69
Objective 2.3 *List common types of computers, and discuss their main features.*

ACTIVE HELPDESK: Understanding Bits and Bytes 69

BITS&BYTES: Today's Supercomputers: Faster Than Ever 73

Input Devices 73

Physical Keyboards and Touch Screens 73
Objective 2.4 *Identify the main types of keyboards and touch screens.*

Mice and Other Pointing Devices 75
Objective 2.5 *Describe the main types of mice and pointing devices.*

DIG DEEPER: How Touch Screens Work 76

BITS&BYTES: Distributed Computing: Putting Your Computer to Work While You Sleep 77

Image, Sound, and Sensor Input 77
Objective 2.6 *Explain how images, sounds, and sensor data are input into computing devices.*

Output Devices 79

Image and Audio Output 79
Objective 2.7 *Describe options for outputting images and audio from computing devices.*

BITS&BYTES: Foldable Phones Are Here 81

Printers 81
Objective 2.8 *Describe various types of printers, and explain when you would use them.*

BITS&BYTES: CPUs That Fight Back 84

TRY THIS: What's Inside My Computer? 86

MAKE THIS: TOOL: App Inventor 2 or Thunkable 87

Part 2: Processing, Storage, and Connectivity 88

Learning Outcome 2.2 You will be able to describe how computers process and store data and how devices connect to a computer system.

Processing and Memory on the Motherboard 88

The Motherboard and Memory 88
Objective 2.9 *Describe the functions of the motherboard and RAM.*

SOUND BYTE: Smartphones Are Really Smart 89

Processing 89
Objective 2.10 *Explain the main functions of the CPU.*

Storing Data and Information 90

Storage Options on Computing Devices 90
Objective 2.11 *Describe the various means of storing data and information with computing devices.*

ETHICS IN IT: What Is Ethical Computing? 92

TRENDS IN IT: Green Computing (Green IT) 93

Connecting Peripherals to the Computer 94

Computer Ports 94
Objective 2.12 *Describe common types of ports used today.*

HELPDESK: Exploring Storage Devices and Ports 94

Power Management and Ergonomics **95**
Power Controls and Power Management 95
Objective 2.13 *Describe how to manage power consumption on computing devices.*
Setting It All Up: Ergonomics 97
Objective 2.14 *Define ergonomics, and discuss the ideal physical setup for using computing devices.*
BITS&BYTES: Coming Soon: USB 4 and DisplayPort 2 97
SOLVE THIS: Technology Wish List 107

Chapter 3

Using the Internet: Making the Most of the Web's Resources 108

Part 1: Collaborating and Working on the Web **110**
Learning Outcome 3.1 **You will be able to explain how the Internet works and how it is used for collaboration, communication, commerce, and entertainment purposes.**

The Internet and How It Works **110**
The Origin of the Internet 110
Objective 3.1 *Describe how the Internet got its start.*
How the Internet Works 112
Objective 3.2 *Explain how data travels on the Internet.*

Collaborating and Communicating on the Web **113**
Collaborating with Web Technologies 113
Objective 3.3 *Evaluate the tools and technologies used to collaborate on the web.*
BITS&BYTES: Secure Messaging Apps 115
SOUND BYTE: Blogging 115
Communicating over the Web 117
Objective 3.4 *Summarize the technologies used to communicate over the web.*

Conducting Business on the Web **120**
Conducting Business Online 120
Objective 3.5 *Describe how business is conducted using the Internet.*
E-Commerce Safeguards 120
Objective 3.6 *Summarize precautions you should take when doing business online.*
DIG DEEPER: How Cloud Computing Works 121
BITS&BYTES: Looking for Extra Money? Try a Side Hustle 122
HELPDESK: Doing Business Online 123
BITS&BYTES: Bitcoin: A Form of Virtual Currency 123
TRY THIS: Use OneDrive to Store and Share Your Files in the Cloud 125
MAKE THIS: TOOL: App Inventor 2 or Thunkable 126

Part 2: Using the Web Effectively **127**
Learning Outcome 3.2 **You will be able to describe the tools and techniques required to navigate and search the web.**

Accessing and Moving Around the Web **127**
Web Browsers 127
Objective 3.7 *Explain what web browsers are, and describe their common features.*
URLs, Protocols, and Domain Names 129
Objective 3.8 *Explain what a URL is and discuss its main parts.*
Navigating the Web 130
Objective 3.9 *Describe tools used to navigate the web.*
BITS&BYTES: Maintain Your Privacy While Searching the Web 131

Searching the Web Effectively **132**
Using Search Engines 132
Objective 3.10 *Describe the types of tools used to search the web, and summarize strategies used to refine search results.*

BITS&BYTES: Digital Assistants and Predictive Search 133
SOUND BYTE: Finding Information on the Web 135
Evaluating Websites 135
Objective 3.11 *Describe how to evaluate a website to ensure it is appropriate to use for research purposes.*
HELPDESK: Evaluating Websites 135
TRENDS IN IT: Linked Data and the Semantic Web 136
BITS&BYTES: Why Isn't Wikipedia Good to Use as a Source for a Research Paper? 137
Using the Web Ethically 137
Digital Activism 137
Objective 3.12 *Demonstrate an understanding of the ethical issues regarding digital activism.*
Geolocation 138
Objective 3.13 *Demonstrate an understanding of the ethical issues regarding location tracking applications and devices.*
BITS&BYTES: Human-Implanted Data Chips: Protection or Invasive Nightmare? 139
ETHICS IN IT: Cyber Harassment 140
SOLVE THIS: Create a Report: Conducting Research on the Web 147

Chapter 4

Application Software: Programs That Let You Work and Play 148

Part 1: Accessing, Using, and Managing Software 150
Learning Outcome 4.1 You will be able to explain the ways to access and use software and describe how to best manage your software.
Software Basics 150
Application vs. System Software 150
Objective 4.1 *Compare application software and system software.*
Distributing Software 150
Objective 4.2 *Explain the differences between commercial software and open source software and describe models for software distribution.*
BITS&BYTES: Finding Alternative Software 151
Managing Your Software 151
Purchasing Software 151
Objective 4.3 *Explain the different options for purchasing software.*
TRENDS IN IT: Mobile Payment Apps: The Power of M-Commerce 152
HELPDESK: Buying and Installing Software 153
Installing and Uninstalling Software 153
Objective 4.4 *Describe how to install and uninstall software.*
BITS&BYTES: Ridding Your Computer of "Bloat" 153
Upgrading Software 154
Objective 4.5 *Explain the considerations around the decision to upgrade your software.*
DIG DEEPER: How Number Systems Work 154
Software Licenses 155
Objective 4.6 *Explain how software licenses function.*
SOUND BYTE: Where Does Binary Show Up? 155
ETHICS IN IT: Can I Install Software That I Don't Own? 157
TRY THIS: Citing Website Sources 159
MAKE THIS: TOOL: App Inventor 2 or Thunkable 160

Part 2: Application Software 161
Learning Outcome 4.2 Describe the different types of application software used for productivity and multimedia.
Productivity and Business Software 161
Productivity Software 161
Objective 4.7 *Categorize the types of application software used to enhance productivity and describe their uses and features.*

BITS&BYTES: Productivity Software Tips and Tricks 161
BITS&BYTES: How to Open Unknown File Types 162
BITS&BYTES: Going Beyond PowerPoint 166
SOUND BYTE: Programming for End Users 168
Business Software 170
Objective 4.8 *Summarize the types of software that large and small businesses use.*
BITS&BYTES: Need to Work as a Team? Try These Collaboration Tools 172
Multimedia and Educational Software 172
Digital Multimedia Software 172
Objective 4.9 *Describe the uses and features of digital multimedia software.*
Digital Audio Software 174
Objective 4.10 *Describe the uses and features of digital audio software.*
HELPDESK: Choosing Software 175
App Creation Software 175
Objective 4.11 *Describe the features of app creation software.*
BITS&BYTES: Mirror, Mirror 177
Educational and Reference Software 177
Objective 4.12 *Categorize educational and reference software and explain their features.*
SOLVE THIS: Analyzing Benchmark Data 185

Chapter 5

System Software: The Operating System, Utility Programs, and File Management 186

Part 1: Understanding System Software 188

Learning Outcome 5.1 You will be able to explain the types and functions of operating systems and explain the steps in the boot process.

Operating System Fundamentals 188
Operating System Basics 188
Objective 5.1 *Discuss the functions of the operating system.*
Operating Systems for Personal Use 188
Objective 5.2 *Explain the most popular operating systems for personal use.*
BITS&BYTES: Quick Assist 190
BITS&BYTES: Operating Systems for the Smart Home 190
Operating Systems for Machinery, Networks, and Business 191
Objective 5.3 *Explain the different kinds of operating systems for machines, networks, and business.*
ETHICS IN IT: The Great Debate: Is macOS Safer Than Windows? 192
What the Operating System Does 193
The User Interface 194
Objective 5.4 *Explain how the operating system provides a means for users to interact with the computer.*
Hardware Coordination 194
Objective 5.5 *Explain how the operating system helps manage hardware such as the processor, memory, storage, and peripheral devices.*
SOUND BYTE: Using Windows Task Manager to Evaluate System Performance 194
Software Application Coordination 196
Objective 5.6 *Explain how the operating system interacts with application software.*
TRENDS IN IT: Are Personal Computers Becoming More Human? 197
Starting Your Computer 198
The Boot Process 198
Objective 5.7 *Discuss the process the operating system uses to start up the computer and how errors in the boot process are handled.*

HELPDESK: Starting the Computer: The Boot Process 200
TRY THIS: Using Virtual Desktops in Windows 10 202
MAKE THIS: TOOL: App Inventor 2 or Thunkable 203

Part 2: Using System Software 204

Learning Outcome 5.2 You will be able to describe how to use system software, including the user interface, file management capabilities, and utility programs.

The Windows Interface 204
Using Windows 10 204
Objective 5.8 *Describe the main features of the Windows interface.*
BITS&BYTES: Snip and Sketch 205

File Management 207
Organizing Your Files 207
Objective 5.9 *Summarize how the operating system helps keep your computer organized and manages files and folders.*
BITS&BYTES: Save Files in the Cloud 209
BITS&BYTES: Using Storage Sense 210
HELPDESK: Organizing Your Computer: File Management 211

Utility Programs 213
Windows Administrative Utilities 214
Objective 5.10 *Outline the tools used to enhance system productivity, back up files, and provide accessibility.*
DIG DEEPER: How Disk Defragmenting Utilities Work 216
SOUND BYTE: Hard Disk Anatomy 216
SOLVE THIS: Operating Systems: Analyzing Market Share 225

Chapter 6

Understanding and Assessing Hardware: Evaluating Your System 226

Part 1: Evaluating Key Subsystems 228

Learning Outcome 6.1 You will be able to evaluate your computer system's hardware functioning, including the CPU and memory subsystems.

Your Ideal Computing Device 228
Moore's Law 228
Objective 6.1 *Describe the changes in CPU performance over the past several decades.*
Selecting a Computing Device 229
Objective 6.2 *Compare and contrast a variety of computing devices.*

Evaluating the CPU Subsystem 231
How the CPU Works 231
Objective 6.3 *Describe how a CPU is designed and how it operates.*
BITS&BYTES: Liquid Cooling 235
Measuring CPU Performance 235
Objective 6.4 *Describe tools used to measure and evaluate CPU performance.*
DIG DEEPER: The Machine Cycle 237

Evaluating the Memory Subsystem 238
Random Access Memory 238
Objective 6.5 *Discuss how RAM is used in a computer system.*
Adding RAM 240
Objective 6.6 *Evaluate whether adding RAM to a system is desirable.*
HELPDESK: Evaluating Your CPU and RAM 240
SOUND BYTE: Installing RAM 241
TRY THIS: Measure Your System Performance 243
MAKE THIS: TOOL: App Inventor 2 or Thunkable 244

Part 2: Evaluating Other Subsystems and Making a Decision 245

Learning Outcome 6.2 You will be able to evaluate your computer system's storage subsystem, media subsystem, and reliability and decide whether to purchase a new system or upgrade an existing one.

Evaluating the Storage Subsystem 245

Types of Storage Drives 245
Objective 6.7 *Classify and describe the major types of nonvolatile storage drives.*

SOUND BYTE: Installing an SSD Drive 246

DIG DEEPER: How Storage Devices Work 247

Storage Needs 248
Objective 6.8 *Evaluate the amount and type of storage needed for a system.*

BITS&BYTES: How Hot Is My GPU? 250

Evaluating the Media Subsystems 251

Video Cards 251
Objective 6.9 *Describe the features of video cards.*

BITS&BYTES: Make Your Tablet a Second Monitor 253

TRENDS IN IT: USB 3.2 C Ports: One Port to Rule Them All! 254

Sound Cards 255
Objective 6.10 *Describe the features of sound cards.*

HELPDESK: Evaluating Computer System Components 255

Evaluating System Reliability and Moving On 257

Maintaining System Reliability 257
Objective 6.11 *Describe steps you can take to optimize your system's reliability.*

Getting Rid of Your Old Computer 259
Objective 6.12 *Discuss how to recycle, donate, or dispose of an older computer.*

ETHICS IN IT: Free Hardware for All 260

SOLVE THIS: Laptop Alternatives 267

Chapter 7

Networking: Connecting Computing Devices 268

Part 1: How Networks Function 270

Learning Outcome 7.1 You will be able to explain the basics of networking, including the components needed to create a network, and describe the different ways a network can connect to the Internet.

Networking Fundamentals 270

Understanding Networks 270
Objective 7.1 *Describe computer networks and their pros and cons.*

HELPDESK: Understanding Networking 271

Network Architectures 272

Network Designs 272
Objective 7.2 *Explain the different ways networks are defined.*

DIG DEEPER: P2P File Sharing 274

Network Components 275

Transmission Media 275
Objective 7.3 *Describe the types of transmission media used in networks.*

SOUND BYTE: Installing a Home Computer Network 275

Basic Network Hardware 277
Objective 7.4 *Describe the basic hardware devices necessary for networks.*

Network Software 278
Objective 7.5 *Describe the type of software necessary for networks.*

TRENDS IN IT: How Smart Is Your Home? 279

Connecting to the Internet **279**
Broadband Internet Connections 279
Objective 7.6 *Summarize the broadband options available to access the Internet.*
BITS&BYTES: Net Neutrality 280
BITS&BYTES: Who's Not on Broadband? 281
Wireless Internet Access 281
Objective 7.7 *Summarize how to access the Internet wirelessly.*
TRY THIS: Testing Your Internet Connection Speed 283
MAKE THIS: TOOL: Ping and Telnet 284

Part 2: Your Home Network **285**
Learning Outcome 7.2 You will be able to describe what is necessary to install and configure a home network and how to manage and secure a wireless network.

Installing and Configuring Home Networks **285**
Planning Your Home Network 285
Objective 7.8 *Explain what should be considered before creating a home network.*
BITS&BYTES: Power Your Devices—Wirelessly 286
Connecting Devices to a Network 286
Objective 7.9 *Describe how to set up a home network.*
BITS&BYTES: Mesh Networks: An Emerging Alternative 288
BITS&BYTES: Analyzing Network Problems 290

Managing and Securing Wireless Networks **290**
Troubleshooting Wireless Network Problems 290
Objective 7.10 *Describe the potential problems with wireless networks and the means to avoid them.*
Securing Wireless Networks 290
Objective 7.11 *Describe how to secure wireless home networks.*
SOUND BYTE: Securing Wireless Networks 292
HELPDESK: Managing and Securing Your Wireless Network 292
SOLVE THIS: Home Networking Guide 299

Chapter 8

Managing Your Digital Lifestyle: Challenges and Ethics 300

Part 1: The Impact of Digital Information **302**
Learning Outcome 8.1 You will be able to describe the nature of digital signals; how digital technology is used to produce and distribute digital texts, music, and video; and the challenges in managing a digital lifestyle.

Digital Basics **302**
Digital Convergence and the Internet of Things 302
Objective 8.1 *Describe how digital convergence and the Internet of Things have evolved.*
Digital versus Analog 304
Objective 8.2 *Explain the differences between digital and analog signals.*

Digital Publishing **306**
e-Readers 306
Objective 8.3 *Describe the different types of e-readers.*
Using e-Texts 307
Objective 8.4 *Explain how to purchase, borrow, and publish e-texts.*
HELPDESK: Managing Digital Media 307

Digital Music **308**
Creating and Storing Digital Music 308
Objective 8.5 *Describe how digital music is created and stored.*
Distributing Digital Music 310
Objective 8.6 *Summarize how to listen to and publish digital music.*

Digital Media **311**
Digital Photography 311
Objective 8.7 *Explain how best to create, print, and share digital photos.*
SOUND BYTE: Enhancing Photos with Image-Editing Software 312
Digital Video 313
Objective 8.8 *Describe how to create, edit, and distribute digital video.*
TRENDS IN IT: Digital Asset Managers Needed! 316
Managing Your Digital Lifestyle **316**
Digital Challenges and Dilemmas 317
Objective 8.9 *Discuss the challenges in managing an active digital lifestyle.*
DIG DEEPER: Deep Web versus Dark Web: Are There Places You Shouldn't Go? 318
BITS&BYTES: The Rise of Wearable Technology 319
BITS&BYTES: Goodbye Net Neutrality. . .Hello Bandwidth Throttling 321
TRY THIS: Creating and Publishing a Movie 323
MAKE THIS: TOOL: App Inventor 2 or Thunkable 324

Part 2: Ethical Issues of Living in the Digital Age **325**
Learning Outcome 8.2 You will be able to describe how to respect digital property and use it in ways that maintain your digital reputation.
Protection of Digital Property **325**
Intellectual Property 325
Objective 8.10 *Describe the various types of intellectual property.*
Copyright Basics 326
Objective 8.11 *Explain how copyright is obtained and the rights granted to the owners.*
HELPDESK: Understanding Intellectual Property and Copyright 328
Copyright Infringement 329
Objective 8.12 *Explain copyright infringement, summarize the potential consequences, and describe situations in which you can legally use copyrighted material.*
BITS&BYTES: Software Piracy: It's More Than Just Downloading and Copying 331
BITS&BYTES: Your Tax Dollars at Work: Free Media without Permission! 333
Living Ethically in the Digital Era **334**
Plagiarism 334
Objective 8.13 *Explain plagiarism and strategies for avoiding it.*
Hoaxes and Digital Manipulation 336
Objective 8.14 *Describe hoaxes and digital manipulation.*
SOUND BYTE: Plagiarism and Intellectual Property 336
Protecting Your Online Reputation 339
Objective 8.15 *Describe what comprises your online reputation and how to protect it.*
BITS&BYTES: Celebrity Photographic Rights 341
ETHICS IN IT: Acceptable Use Policies: What You Can and Can't Do 342
SOLVE THIS: Intellectual Property and Copyright Basics 349

Chapter 9

Securing Your System: Protecting Your Digital Data and Devices 350

Part 1: Threats to Your Digital Assets **352**
Learning Outcome 9.1 You will be able to describe hackers, viruses, and other online annoyances and the threats they pose to your digital security.
Identity Theft and Hackers **352**
Identity Theft 353
Objective 9.1 *Describe how identity theft is committed and the types of scams identity thieves perpetrate.*

Hacking 353
Objective 9.2 *Describe the different types of hackers and the tools they use.*
BITS&BYTES: Next Generation White Hat Hackers 354
Computer Viruses 357
Virus Basics 357
Objective 9.3 *Explain what a computer virus is, why it is a threat to your security, how a computing device catches a virus, and the symptoms it may display.*
SOUND BYTE: Protecting Your Computer 358
Types of Viruses 359
Objective 9.4 *List the different categories of computer viruses, and describe their behaviors.*
Online Annoyances and Social Engineering 360
Online Annoyances 361
Objective 9.5 *Explain what malware, spam, and cookies are and how they impact your security.*
Social Engineering 363
Objective 9.6 *Describe social engineering techniques, and explain strategies to avoid falling prey to them.*
BITS&BYTES: I Received a Data Breach Letter . . . Now What? 364
ETHICS IN IT: You're Being Watched . . . But Are You Aware You're Being Watched? 366
HELPDESK: Threats to Your Digital Life 366
TRENDS IN IT: Spear Phishing: The Bane of Data Breaches 367
TRY THIS: Testing Your Network Security 369
MAKE THIS: App Inventor 2 or Thunkable 370
Part 2: Protecting Your Digital Property 371
Learning Outcome 9.2 Describe various ways to protect your digital property and data from theft and corruption.
Restricting Access to Your Digital Assets 371
Firewalls 371
Objective 9.7 *Explain what a firewall is and how a firewall protects your computer from hackers.*
Preventing Virus Infections 373
Objective 9.8 *Explain how to protect your computer from virus infection.*
HELPDESK: Understanding Firewalls 373
Authentication: Passwords and Biometrics 376
Objective 9.9 *Describe how passwords and biometric characteristics can be used for user authentication.*
BITS&BYTES: CAPTCHA: Keeping Websites Safe from Bots 376
Anonymous Web Surfing: Hiding from Prying Eyes 378
Objective 9.10 *Describe ways to surf the Web anonymously.*
BITS&BYTES: Multi-Factor Authentication: Don't Rely Solely on Passwords! 380
Keeping Your Data Safe 380
Protecting Your Personal Information 380
Objective 9.11 *Describe the types of information you should never share online.*
SOUND BYTE: Managing Computer Security with Windows Tools 380
Backing Up Your Data 381
Objective 9.12 *List the various types of backups you can perform on your computing devices, and explain the various places you can store backup files.*
Protecting Your Physical Computing Assets 385
Environmental Factors and Power Surges 385
Objective 9.13 *Explain the negative effects environment and power surges can have on computing devices.*
Preventing and Handling Theft 385
Objective 9.14 *Describe the major concerns when a device is stolen and strategies for solving the problems.*
DIG DEEPER: Computer Forensics: How It Works 387
SOLVE THIS: Computer Security 395

Chapter 10

Behind the Scenes: Software Programming 396

Part 1: Understanding Programming 398

Learning Outcome 10.1 You will be able to describe the life cycle of a software project and identify the stages in the program development life cycle.

Life Cycle of an Information System 398

The Importance of Programming 398
Objective 10.1 *Describe the importance of programming to both software developers and users.*

System Development Life Cycle 398
Objective 10.2 *Summarize the stages of the system development life cycle.*

BITS&BYTES: The Agile Scrum 400

Life Cycle of a Program 400

The Program Development Life Cycle 400
Objective 10.3 *Define programming and list the steps in the program development life cycle.*

The Problem Statement 401
Objective 10.4 *Describe how programmers construct a complete problem statement from a description of a task.*

SOUND BYTE: Using the Arduino Microcontroller 401

HELPDESK: Understanding Software Programming 402

Algorithm Development 403
Objective 10.5 *Explain how programmers use flow control and design methodologies when developing algorithms.*

BITS&BYTES: Coding with a Purpose 406

DIG DEEPER: The Building Blocks of Programming Languages: Syntax, Keywords, Data Types, and Operators 408

Coding 409
Objective 10.6 *Discuss the categories of programming languages and the roles of the compiler and the integrated development environment in coding.*

Debugging 415
Objective 10.7 *Identify the role of debugging in program development.*

BITS&BYTES: Many Languages on Display 416

Testing and Documentation 416
Objective 10.8 *Explain the importance of testing and documentation in program development.*

TRY THIS: Programming with Corona 418

MAKE THIS: TOOL: App Inventor 2 or Thunkable 419

Part 2: Programming Languages 420

Learning Outcome 10.2 You will understand the factors programmers consider when selecting an appropriate programming language for a specific problem and will be familiar with some modern programming languages.

Many Programming Languages 420

Need for Diverse Languages 420
Objective 10.9 *Discuss the driving factors behind the popularity of various programming languages.*

SOUND BYTE: Programming with the Processing Language 420

Selecting the Right Language 421
Objective 10.10 *Summarize the considerations in identifying an appropriate programming language for a specific setting.*

BITS&BYTES: Learn to Code for Free at freeCodeCamp 421

ETHICS IN IT: When Software Runs Awry 422

Exploring Programming Languages 423

Tour of Modern Languages 423
Objective 10.11 *Compare and contrast modern programming languages.*

BITS&BYTES: Your Software Portfolio 427

TRENDS IN IT: Emerging Technologies: Unite All Your Video Game Design Tools 431

Future of Programming Languages 431
Objective 10.12 *State key principles in the development of future programming languages.*
HELPDESK: A Variety of Programming Languages 432
SOLVE THIS: Time Sheets 439

Chapter 11

Behind the Scenes: Databases and Information Systems 440

Part 1: Database Fundamentals 442

Learning Outcome 11.1 You will be able to explain the basics of databases, including the most common types of databases and the functions and components of relational databases in particular.

The Need for Databases 442
Database Basics 442
Objective 11.1 *Explain what a database is and why databases are useful.*

Database Types 444
Flat Databases 444
Objective 11.2 *Describe features of flat databases.*
Relational Databases 446
Objective 11.3 *Describe features of relational databases.*
BITS&BYTES: Normal Forms 447
Object-Oriented Databases 447
Objective 11.4 *Describe features of object-oriented databases.*
Multidimensional Databases 447
Objective 11.5 *Describe features of multidimensional databases.*
HELPDESK: Using Databases 447
NoSQL Databases 448
Objective 11.6 *Describe how Web 2.0 data is managed in a database.*

Using Databases 449
Relational Database Components and Functions 449
Objective 11.7 *Describe how relational databases organize and define data.*
SOUND BYTE: Creating and Querying an Access Database 452
BITS&BYTES: Music Streaming Services Use Databases 453
Inputting and Managing Data 453
Objective 11.8 *Describe how data is inputted and managed in a database.*
DIG DEEPER: Structured Query Language (SQL) 458
BITS&BYTES: Data Dashboards: Useful Visualization Tools 460
TRY THIS: Using Excel's Database Functions 462
MAKE THIS: TOOL: App Inventor 2 or Thunkable 463

Part 2: How Businesses Use Databases 464

Learning Outcome 11.2 You will be able to explain how businesses use data warehouses, data marts, and data mining to manage data and how business information systems and business intelligence are used to make business decisions.

Data Warehousing and Storage 464
Data Warehouses and Data Marts 464
Objective 11.9 *Explain what data warehouses and data marts are and how they are used.*
HELPDESK: How Businesses Use Databases 464
BITS&BYTES: Data Warehouses Are Going to the Cloud 465
Data Mining 466
Objective 11.10 *Describe data mining and how it works.*
BITS&BYTES: Hadoop: How Big Data Is Being Managed 467
ETHICS IN IT: Data, Data Everywhere—But Is It Protected? 469

Using Databases to Make Business Decisions **469**
Business Information Systems 469
Objective 11.11 *Describe the main types of business information systems and how they are used by business managers.*
SOUND BYTE: Analyzing Data with Microsoft Power BI Suite 474
BITS&BYTES: Virtual Agents: Expert Systems Replace People on the Web 474
TRENDS IN IT: Mobile Business Intelligence 475
SOLVE THIS: College Database 483

Chapter 12

Behind the Scenes: Networking and Security in the Business World 484

Part 1: Client/Server Networks and Topologies **486**
Learning Outcome 12.1 **You will be able to describe common types of client/server networks, servers found on them, and network topologies used to construct them.**
Client/Server Network Basics **486**
Networking Advantages 486
Objective 12.1 *List the advantages for businesses of installing a network.*
Comparing Client/Server and Peer-to-Peer Networks 487
Objective 12.2 *Explain the differences between a client/server network and a peer-to-peer network.*
Types of Client/Server Networks 488
Objective 12.3 *Describe the common types of client/server networks as well as other networks businesses use.*
BITS&BYTES: Make Your Browser Protect You! 491
Servers and Network Topologies **492**
Servers 492
Objective 12.4 *List the common types of servers found on client/server networks.*
HELPDESK: Using Servers 493
TRENDS IN IT: Virtualization: Making Servers Work Harder 494
Network Topologies 495
Objective 12.5 *Describe the common types of network topologies and the advantages and disadvantages of each one.*
SOUND BYTE: Network Topology and Navigation Devices 497
TRY THIS: Sharing Printers on a Network Using Windows 502
MAKE THIS: TOOL: App Inventor 2 or Thunkable 503
Part 2: Setting Up Business Networks **504**
Learning Outcome 12.2 **You will be able to describe transmission media, network operating system software, and network navigation devices and explain major threats to network security and how to mitigate them.**
Transmission Media **504**
Wired and Wireless Transmission Media 504
Objective 12.6 *Describe the types of wired and wireless transmission media used in networks.*
BITS&BYTES: Guidance on Green Computing 506
Network Adapters and Navigation Devices **506**
Network Adapters 506
Objective 12.7 *Describe how network adapters help data move around a network.*
MAC Addresses 508
Objective 12.8 *Define MAC addresses, and explain how they are used to move data around a network.*
Switches, Bridges, and Routers 509
Objective 12.9 *List the various network navigation devices, and explain how they help route data through networks.*
HELPDESK: Transmission Media and Network Adapters 510
Network Operating Systems and Network Security **510**
Network Operating Systems 511
Objective 12.10 *Explain why network operating systems are necessary for networks to function.*
BITS&BYTES: Extending Smart Homes: Smart Yards Coming Soon! 511

Client/Server Network Security 512
Objective 12.11 *List major security threats to networks, and explain how network administrators mitigate these threats.*
DIG DEEPER: The OSI Model: Defining Protocol Standards 513
SOUND BYTE: A Day in the Life of a Network Technician 514
ETHICS IN IT: How Should Companies Handle Data Breaches? 517
BITS&BYTES: Logging in? Try Finger Vein Recognition 518
SOLVE THIS: Cyber-Security Flyer and Mail Merge 525

Chapter 13

Behind the Scenes: How the Internet Works 526

Part 1: Inner Workings of the Internet 528

Learning Outcome 13.1 You will be able to explain how the Internet is managed and the details of how data is transmitted across the Internet.

Internet Management and Networking 528
Management 528
Objective 13.1 *Describe the management of the Internet.*
Networking Components 529
Objective 13.2 *Explain how the Internet's networking components interact.*
Data Transmission 530
Objective 13.3 *List and describe the Internet protocols used for data transmission.*
BITS&BYTES: A Free Cloud-Based Server for You 530

Internet Identity 533
IP Addresses 533
Objective 13.4 *Explain how each device connected to the Internet is assigned a unique address.*
HELPDESK: Understanding IP Addresses, Domain Names, and Protocols 533
BITS&BYTES: What's Your IP Address? 534
BITS&BYTES: Amazing Applications of IoT 534
SOUND BYTE: Creating Web Pages with Squarespace 535
DIG DEEPER: Connection-Oriented Versus Connectionless Protocols 536
Domain Names 537
Objective 13.5 *Discuss how a numeric IP address is changed into a readable name.*
BITS&BYTES: Scale Up for Success 538
TRY THIS: Ping Me 541
MAKE THIS: TOOL App Inventor 2 or Thunkable 542

Part 2: Coding and Communicating on the Internet 543

Learning Outcome 13.2 You will be able to describe the web technologies used to develop web applications.

Web Technologies 543
Web Development 543
Objective 13.6 *Compare and contrast a variety of web development languages.*
BITS&BYTES: CodePen: An Editing Community for Web Designers 544
Application Architecture 546
Objective 13.7 *Compare and contrast server-side and client-side application software.*
SOUND BYTE: Client-Side Web Page Development 547
BITS&BYTES: Repl It 549

Communications over the Internet 549
Types of Internet Communication 549
Objective 13.8 *Discuss the mechanisms for communicating via e-mail and instant messaging.*
BITS&BYTES: AI and Your Inbox 551
Encryption 552
Objective 13.9 *Explain how data encryption improves security.*

BITS&BYTES: Numbers: We Wouldn't Have Encryption Without Them! 553
ETHICS IN IT: Do We Really Want Strong Encryption? 554
HELPDESK: Keeping E-Mail Secure 554
TRENDS IN IT: Cognitive Computing 555
SOLVE THIS: Creating an HTML Document 563

Appendix A

The History of the Personal Computer 564

Appendix B

Careers in IT 576

Glossary 590
Index 608