

GLOBAL
EDITION



Technology in Action

Complete

SIXTEENTH EDITION

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Don't just read about technology, interact with it.

HELPDESKS

These highly-interactive, almost game-like simulations let you take the role of a helpdesk staffer where you answer computer technology questions from customers. These simulations help reinforce the book content in a fun, engaging way.

CHAPTER 1

Technology Impacts
The Impact of Artificial
Intelligence

CHAPTER 2

Understanding Bits
and Bytes
Exploring Storage
Devices and Ports

CHAPTER 3

Doing Business
Online
Evaluating Websites

CHAPTER 4

Buying and Installing
Software
Choosing Software

CHAPTER 5

Starting the
Computer: The
Boot Process
Organizing Your
Computer:
File Management

CHAPTER 6

Evaluating Your CPU
and RAM
Evaluating Computer
System
Components

CHAPTER 7

Understanding
Networking
Managing and
Securing Wireless
Networks

CHAPTER 8

Managing Digital
Media
Understanding
Intellectual Property
and Copyright

CHAPTER 9

Threats to Your
Digital Life
Understanding
Firewalls

CHAPTER 10

Understanding
Software
Programming
A Variety of
Programming
Languages

CHAPTER 11

Using Databases
How Businesses
Use Databases

CHAPTER 12

Using Servers
Transmission Media
and Network
Adapters

CHAPTER 13

Understanding IP
Addresses, Domain
Names, and
Protocols
Keeping E-Mail
Secure

SOUND BYTES

These multimedia lessons demystify complex computer concepts with short audio, animation, or video. The Sound Bytes now also include integrated learning objectives, a summary, and a quiz.

CHAPTER 1

Virtual Computer
Tour
How to Debate
Ethical Issues

CHAPTER 2

Binary Numbers
Interactive
Smartphone Are
Really Smart

CHAPTER 3

Blogging
Finding Information
on the Web

CHAPTER 4

Where Does Binary
Show Up?
Programming for
End Users

CHAPTER 5

Using Windows
Task Manager to
Evaluate System
Performance
Hard Disk Anatomy

CHAPTER 6

Installing RAM
Installing an SSD
Drive

CHAPTER 7

Installing a Home
Computer
Network
Securing Wireless
Networks

CHAPTER 8

Enhancing Photos
with Image-Editing
Software
Plagiarism and
Intellectual
Property

CHAPTER 9

Protecting Your
Computer
Managing Computer
Security with
Windows Tools

CHAPTER 10

Using the Arduino
Microcontroller
Programming with
the Processing
Language

CHAPTER 11

Creating and
Querying an
Access Database
Analyzing Data with
Microsoft Power
BI Suite

CHAPTER 12

Network Topology
and Navigation
Devices
A Day in the Life
of a Network
Technician

CHAPTER 13

Creating Web Pages
with Squarespace
Client-Side
Web Page
Development

IT SIMULATIONS

IT Simulations are detailed, interactive scenarios covering the core chapter topic. Students work through the simulations to apply what they have learned and demonstrate understanding in an active learning environment.

CHAPTER 1

Technology and
Ethics

CHAPTER 2

What Is
a Computer?

CHAPTER 3

The Internet

CHAPTER 4

Application Software

CHAPTER 5

System Software

CHAPTER 6

Hardware

CHAPTER 7

Networks

CHAPTER 8

Digital Devices
and Multimedia

CHAPTER 9

Security and
Privacy

CHAPTER 10

Program
Development

CHAPTER 11

Databases

CHAPTER 12

Client/Server
Networks

CHAPTER 13

Communicating,
Sharing on
the Web

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



For a chapter overview, watch the [Chapter Overview videos](#).

PART 1

Understanding System Software

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.

PART 2

Using System Software

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.



Operating System Fundamentals 186

Objective 5.1 Discuss the functions of the operating system.

Objective 5.2 Explain the most popular operating systems for personal use.

Objective 5.3 Explain the different kinds of operating systems for machines, networks, and business.



What the Operating System Does 193

Objective 5.4 Explain how the operating system provides a means for users to interact with the computer.

Objective 5.5 Explain how the operating system helps manage hardware such as the processor, memory, storage, and peripheral devices.

Objective 5.6 Explain how the operating system interacts with application software.

Sound Byte: Using Windows Task Manager to Evaluate System Performance



Starting Your Computer 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



The Windows Interface 204

Objective 5.8 Describe the main features of the Windows interface.



File Management 207

Objective 5.9 Summarize how the operating system helps keep your computer organized and manages files and folders.

Helpdesk: Organizing Your Computer: File Management



Utility Programs 213

Objective 5.10 Outline the tools used to enhance system productivity, back up files, and provide accessibility.

Sound Byte: Hard Disk Anatomy

MyLab IT

All media accompanying this chapter can be found here.

Make This



A Notification Alert on **page 203**

(Dizain/Fotolia; Display intermaya/Fotolia; Revers/Shutterstock; Courtesy of Microsoft Corporation.; Stanislav Popov/Shutterstock; Reji/Fotolia)



What do you think?

Think of the **private information on your smartphone**—your texts, contact lists, and emails. If someone has your phone and can log in to it, could they read your information? Not if it were encrypted. **Encryption takes the data stored on your device and changes it using a secret key.** When you log in to an encrypted phone, it automatically unencrypts the data for you to read. Without the encryption key, the data is just garbled nonsense.

And **if your phone is stolen, even without the means to login, the new “owner” could still get information off of it.** They could plug the SD card into a computer or could use software to read the data stored on the phone memory. But not if your operating system encrypted it.

Almost all **modern smartphones offer encryption.** However, tech companies have faced legal action from government agencies when, for example, the FBI wants to break into the phone of a suspect to look for evidence of crime. **Law enforcement wants tech companies to work on a way to defeat the encryption installed in the device** or to add a “backdoor” that would allow the companies to defeat the encryption any time they are asked to. The debate over how much privacy you should expect is an important one.

?

We need to balance the privacy rights of individuals against the need for security. Which position should tech companies take?

- *Produce products that support full encryption that can't be broken by anyone – even the tech company*
- *Produce products that support encryption but enable the tech company to defeat it if asked to by authorities*
- *Produce products that do not support encryption so that law enforcement can access the data*



Understanding System Software

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.

Your computer uses two basic types of software: application software and system software. *Application software* is the software you use to do everyday tasks at home and at work. *System software* is the set of programs that helps run the computer and coordinates instructions between application software and the computer's hardware devices. From the moment you turn on your computer to the time you shut it down, you're interacting with system software.



Operating System Fundamentals

Every computer, from smartphones to supercomputers, has an operating system. Even game consoles, cars, and some appliances have operating systems. The role of the operating system is critical; a computer can't operate without it.

Operating System Basics

Objective 5.1 Discuss the functions of the operating system.

What does the operating system do? System software consists of two primary types of programs: the *operating system* and *utility programs*. The **operating system (OS)** is a group of programs that controls how your computer functions. The operating system has three primary functions:

- *Managing hardware*, including the processor, memory, and storage devices, as well as peripheral devices such as the printer.
- *Managing software*, which allows application software to work with the central processing unit (CPU).
- *Managing tasks*, such as scheduling and coordinating processes (like reading strokes from the keyboard) and managing network resources.

You interact with your OS through the **user interface**—the *desktop*, *icons*, and *menus* that let you communicate with your computer.

How many operating systems are there? There are several operating systems in the marketplace. Microsoft **Windows** and Apple's **macOS** are the most common on desktops and laptops. In terms of mobile devices, operating systems must be designed to manage power and use the limited screen space efficiently. Apple created iOS for use on its tablets, watchOS for use on its Apple Watch, and tvOS for use on its Apple TV product. Meanwhile, Windows 10 is able to run on desktops, laptops, and mobile devices. As devices continue to converge in functionality, developers are making mobile and desktop operating systems that have similar functionality (such as macOS and iOS) or single operating systems (such as Windows 10) that can run on a variety of devices. Table 5.1 lists some popular operating systems.

How are operating systems categorized? Early operating systems were designed for one person performing one task at a time. These are named *single-user*, *single-task operating systems*. Modern operating systems allow a single user to **multitask**—to perform more than one process at a time. And operating systems such as Windows and macOS provide networking capabilities as well, essentially making them *multiuser*, *multitasking operating systems*.

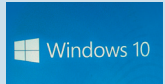





Operating systems can also be categorized by the type of device in which they're installed, such as mobile devices, personal computers, robots or mainframes, and network computers.

Operating Systems for Personal Use

Objective 5.2 Explain the most popular operating systems for personal use.

What are the most popular operating systems for personal computers? Microsoft Windows, Apple macOS, and Linux (an open source OS) are popular operating systems for personal computers. Google's Chrome OS is used on the Chromebook series of devices. Although each OS has unique features, they share many features as well.

Table 5.1 Popular Operating Systems

Operating System Name	Windows	macOS	iOS	Android	Linux	Chrome OS
						
Developed By	Microsoft	Apple	Apple	Google	Open source	Google
Available On	Laptops, tablets, desktops, all-in-ones, smart-phones	Laptops, desktops, all-in-ones	Tablets, iPhones, iPod touches	Smartphones, tablets	Laptops, desktops, tablets	Chromebooks

(Top Photo Corporation/Alamy Stock Photo; David Paul Morris/Bloomberg/Getty Images; YAY Media AS/Alamy Stock Photo; Tibbbb/Fotolia; Rvlsoft/123RF)

What common features are found in personal computer operating systems? All personal computer operating systems include a window-based interface with icons and other graphics that facilitate point-and-click commands. They also include many utility programs. A [utility program](#) is a small program that performs many of the general housekeeping tasks for your computer, to help the computer run more efficiently. Utilities include such things as virus protection, backup and restore software, and system management tools. A set of utility programs is bundled with each OS, but you can also buy stand-alone utility programs that often provide more features.

Other features operating systems incorporate include natural language search capability as well as virtual desktops. They support Bluetooth and WiFi connectivity. Although macOS doesn't have touchscreen capabilities like Windows, iOS offers this capability for iPhones and iPads.

What kind of OS do mobile devices use? Smartphones and tablets use a [mobile operating system](#). [Android](#) is the mobile OS for devices designed by Google, Samsung, and other companies. The main OS for Apple mobile devices is [iOS](#). Both iOS and Android support devices like cameras, the sensors built into mobile devices, touch screen displays, and multiple types of connectivity (WiFi, Bluetooth, NFC). They also support mobile payment systems, on-screen note taking, and voice recognition.

Are any operating systems web-based? [Google Chrome OS](#) (see Figure 5.1), is a web-based OS. With the Chrome OS, very few files are installed on your computing device. Rather, the main functionality of the OS is provided through a web browser. Chrome OS is only available on certain devices called *Chromebooks* from Google and Google's manufacturing partners. Chrome OS should not be confused with the Google Chrome browser. The browser is application software that can run on many different operating systems.

How do other operating systems use the cloud? Operating systems have features that are tied to cloud computing. Using your Microsoft account, Windows 10 stores your settings so you can see your familiar desktop and applications on any device you log into. You can access and store files online from OneDrive, Windows' cloud-based storage system. Similarly, macOS allows you to sign in to any Apple device with your Apple ID, which provides access to Apple's iCloud system. Both systems store your content online and automatically push it out to all your associated devices. There are third-party products that do the same thing (for example Dropbox) but a product built into the OS by the manufacturer is often more tightly integrated into the operating system.

What is Linux? [Linux](#) is a free open source OS designed for use on personal computers and web servers. Open source software is available for anyone to use or modify. Linux began in 1991 as a project of Finnish university student Linus Torvalds. It has since been tweaked by scores of programmers as part of the Free Software Foundation GNU Project ([gnu.org](#)).

Linux has a reputation as a stable OS, one that is not subject to crashes. Because the code is available to anyone, Linux can be updated quickly by programmers around the world.

Where can I get Linux? Linux is available for download in various packages known as [distributions](#) or [distros](#). Distros include the underlying Linux [kernel](#) (the code that provides an operating system's basic functionality) and special modifications to the OS, and may also include additional open source software (such as LibreOffice). A good place to start researching distros is

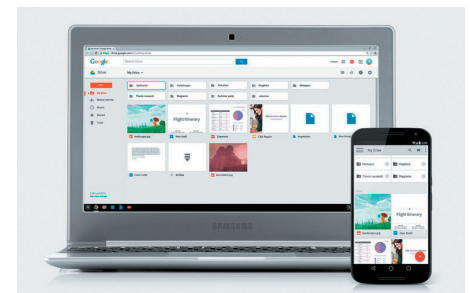


Figure 5.1 The Google Chrome OS is web-based and has a very minimalist look. (Courtesy of Google, Inc.)

Have you ever had a family member or a friend who needed computer help but you didn't have time to drive over and support them? Quick Assist to the rescue! Hit the Start button then type Quick Assist to find the tool. Select Assist Another Person

and send them the code provided. They can now give you remote control of their system. You will see their screen in front of you and take any steps you would have if you were right in the room with them.

distrowatch.com. This site tracks Linux distros and provides helpful tips for beginners on choosing one.

Does it matter what OS is on my computer? Most application software is OS dependent. You need to make sure you get the correct version of software, matched to your OS. Although you might find the same app in Google Play, the Windows store, or the Apple store, you must download and install the app from the specific store that works with your OS.

Can I have more than one OS on my computer? Yes, many people run more than one OS on their computer. Windows and Linux can run on most of the hardware being sold today. And, although macOS and iOS run only on Apple equipment, Apple devices can support Windows and Linux as well. Your choice of an OS is mostly a matter of price and personal preference.

Note that Mac users might install Windows on their computers so they can install and run a program they like that is only available on Windows. A Mac computer can boot up into either Windows or macOS using the utility included in macOS named Boot Camp. You can also run both macOS and Windows at the same time, using software such as Parallels or VMware Fusion.

In Windows, you can create a separate section of your hard drive (called a *partition*) and install Linux on it while leaving your original Windows installation untouched. After installing Linux, when your computer starts, you're offered a choice of which OS to use.

How do I update my OS? Microsoft Windows delivers automatic OS updates, including new features, apps, and patches, as necessary. You can manage your update settings through the Update & Security section of Settings. Advanced options let you choose to automatically download updates or to defer a feature update for a certain amount of time.

Apple releases periodic new versions of its desktop and mobile operating systems. The newest versions as of this writing are iOS 13 and macOS Catalina. These versions for Apple mobile and desktop OSs are pushed to the user, and the user can decide whether to install the updates.

Updates to the mobile Android OS get pushed to users but at the discretion of the device manufacturer. For example, when a new version of Android is released, Samsung may release it immediately for the Galaxy smartphone but may not release it for another Samsung device, whereas LG may choose to delay the release for all its smartphones. If having the latest update on your Android device is important to you, consider purchasing Google hardware since the updates come to Google devices first.

Have you thought about having an operating system for your home? Smart home devices are becoming more inexpensive and powerful. These devices include light switches, alarm systems, doorbell cameras, door locks, garage door openers, and smoke detectors—each connected to the Internet. Having a central controller for your home to manage them all and to provide a consistent interface is important.

Amazon's Echo and Google's Home are two candidates for organizing and controlling your smart home. These devices have operating systems that respond to voice commands and can run your smart devices, as well as send text messages or place or receive phone calls. There are also open source solutions like openHAB (*openhab.org*) that can run on inexpensive hardware like the Raspberry Pi. Explore making your home smarter!

Operating Systems for Machinery, Networks, and Business

Objective 5.3 Explain the different kinds of operating systems for machines, networks, and business.

Why do machines with built-in computers need an OS? Machinery that performs a repetitive series of specific tasks in an exact amount of time requires a **real-time operating system (RTOS)**. Also referred to as *embedded systems*, RTOSs require minimal user interaction. This type of OS is a program with a specific purpose, and it must guarantee certain response times for certain computing tasks; otherwise, the machine is useless. The programs are written specifically for the needs of the devices and their functions. Devices that must perform regimented tasks or record precise results require RTOSs. Examples include a pacemaker or the anti-lock braking system in your car.

You also encounter RTOSs every day in devices such as point of sale systems, fuel-injection systems in car engines, as well as some common appliances. RTOSs are also found in many types of robotic equipment, such as the robotic cameras television stations use that glide across a suspended cable system to record sports events from many angles (see Figure 5.2).

What kind of operating systems do networks use? A **multiuser operating system** (or **network operating system**) lets more than one user access the computer system at a time by handling and prioritizing requests from multiple users. Networks (groups of computers connected to each other so that they can communicate and share resources) need a multiuser OS because many users simultaneously access the server (the computer that manages network resources such as printing and communications). The latest versions of Windows and macOS can be considered network operating systems because they enable multiple computers in a home or small business to connect to each other and share resources.



Figure 5.2 Real-time operating systems can be found in devices such as TV sky cameras, cars, medical equipment, and point of sale machines. (Cal Sport Media/Newscom; Syda Productions/Shutterstock; Elfstrom/E+/Getty Images; Sergiy Zavgorodny/Shutterstock)