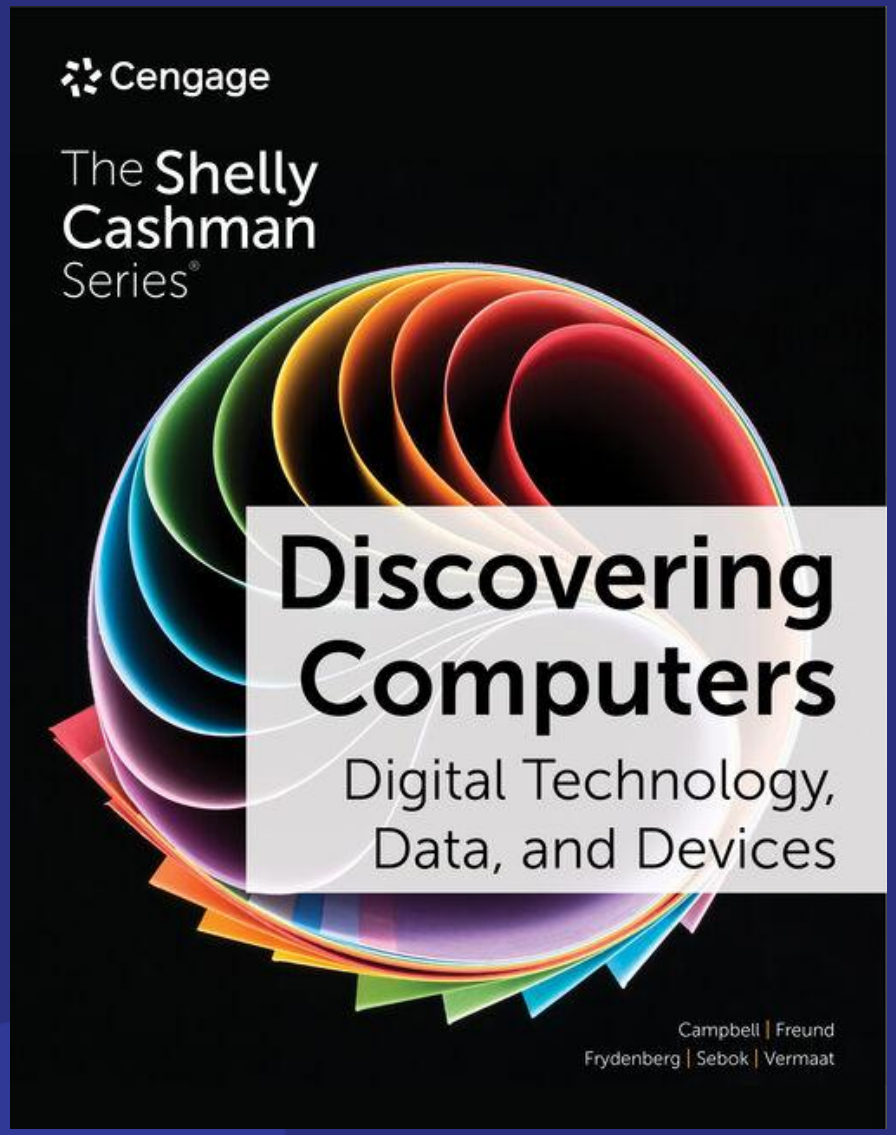


CS 110 – Introduction to Computing

Unit 9: Operating Systems: Managing, Coordinating, and Monitoring Resources

Module Objectives

By the end of the module, you will be able to:

- Explain the purpose of an operating system
- Describe how an operating system works
- Identify types of operating systems
- Explain how to select an operating system
- Explain how to manage files and folders with an operating system
- Describe the uses of operating system management utilities
- Identify operating system security features
- Explain the uses of a virtual machine

Operating Systems (1 of 6)

- **System software** is the software that runs a computer, including the operating system.
- **Operating system** (OS) is a set of programs that coordinate all the activities of computer or mobile device hardware.
- The operating system and utility programs control the behind-the-scenes operations of a computer or mobile device.
- Some operating systems also allow users to control a network and administer security.

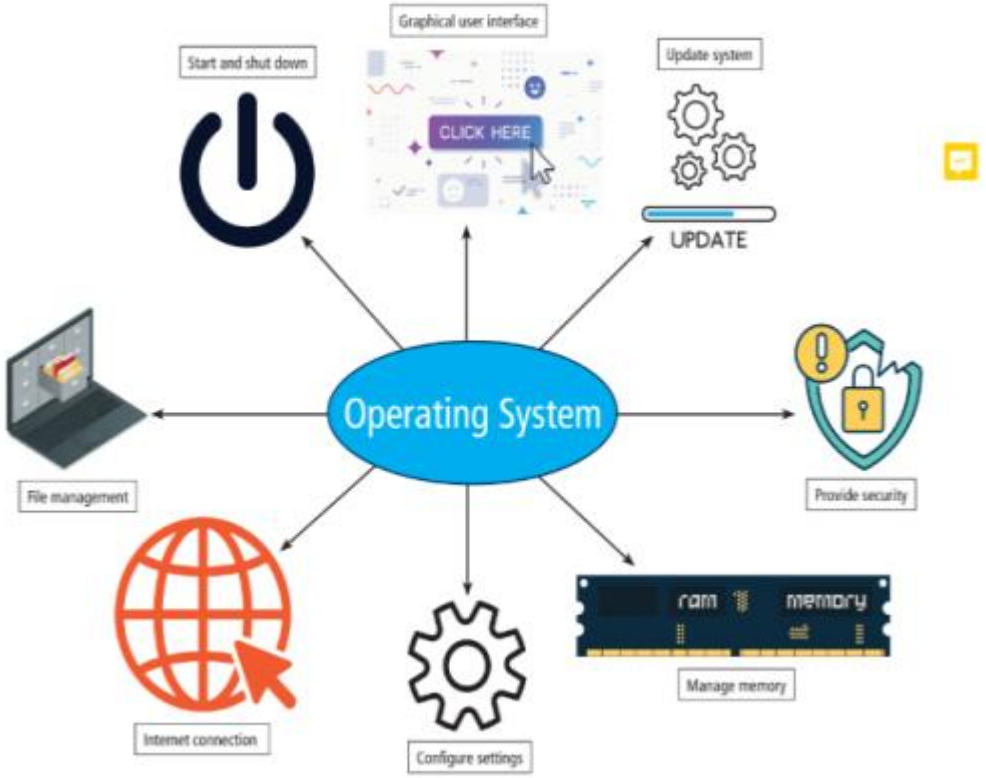


Figure 8-1: Common operating system functions.

Operating Systems (2 of 6)

Table 8-1: Programs and apps by category.

Your task	Role of operating system
Start a word processing program and open a document	• Starts the word processing program • Provides tools for you to open the document file
Add information to the document	• Manages memory so the computer can run • Saves your unsaved work to temporary storage
Save the document on the hard drive	• Find the hard drive • Makes sure the hard drive has enough storage space • Saves the document • Stores the location and file name so that you can access the document later

Operating Systems (3 of 6)

- A **graphical user interface** (GUI) is a collective term for all the ways you interact with the device.
- A **GUI** controls how you interact with menus, programs and apps, and visual images such as icons, by touching, pointing, tapping, or clicking buttons and other objects to issue commands.
- An **icon** is a small picture that represents a program, file, or hardware device.
- A **button** is a graphic that you click to execute commands you need to work with an app, such as on a toolbar, taskbar, or the ribbon.

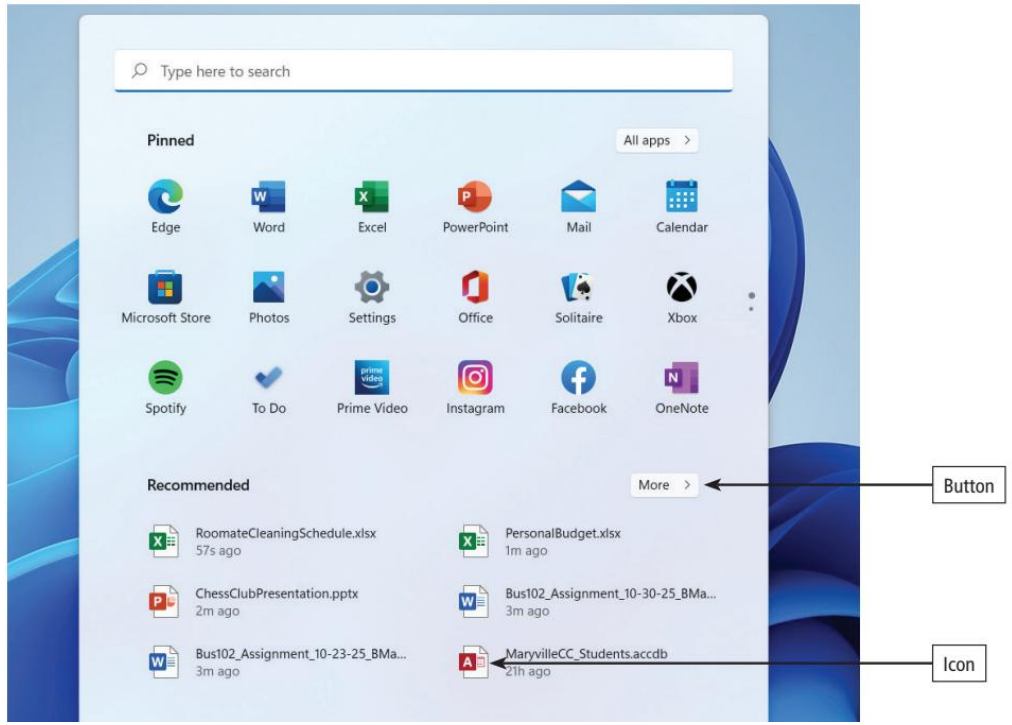


Figure 8-2: Graphical user interface

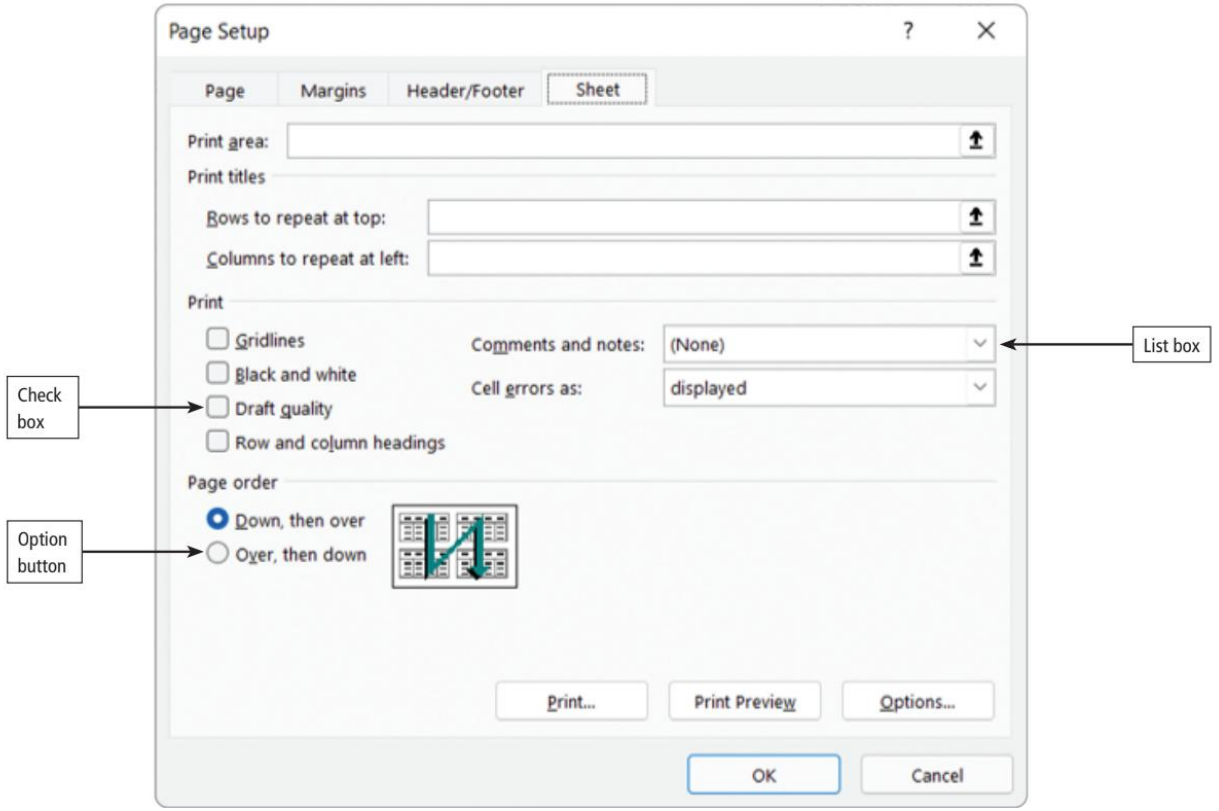
Operating Systems (4 of 6)

- A **menu** is a list of related items, including folders, applications, and commands.
- Many menus organize commands on a **submenu**, which is a list of additional commands associated with the selected **command** on a menu.
- A **shortcut menu** is a list of frequently used commands that relate to an object.
- Some menu commands display a **dialog box**, which is a box with controls that lets you tell the operating system how you want to complete a command.

Operating Systems (5 of 6)

Dialog box controls may include:

- ✓ **Option buttons**: round buttons that present one choice; they are also called radio buttons.
- ✓ **Check boxes**: square boxes that present a yes/no choice and display a check mark or x when selected.
- ✓ **List boxes**: lists of options that appear when you click arrows in a dialog box; some list boxes allow you to make multiple selections.



Operating Systems (6 of 6)

Standard operating system functions include:

- Starting and shutting down a computer or device
- Managing programs
- Managing memory
- Coordinating task
- Configuring devices
- Establishing an Internet connection
- Monitoring performance
- Providing file management
- Updating operating system software
- Monitoring security
- Controlling network access

How an Operating System Works (1 of 6)

- The **operating system** is the essential software or app on your computer or device.
- The operating system also manages interactions between hardware and software.
- **RAM** is the storage location that temporarily stores open apps and document data while a computer or device is on.
- The more RAM a device has, the more efficiently it runs.
- The operating system can allocate a portion of a storage medium, such as a hard disk, to become virtual memory to function as additional RAM.

How an Operating System Works (2 of 6)

- **Virtual memory** allows an operating system to temporarily store data on a storage medium until it can be “swapped” into RAM.
- The technique of swapping items between memory and storage is called **paging**.
- Paging is a time-consuming process.
- Instructions used for processing data can be in the form of a program or app, commands, or user responses.
- The information is processed into **output**.
- For example, a webpage typically combines text and graphics and may include audio and video as well.

How an Operating System Works (3 of 6)

- Most laptops and desktop computers have the option to add memory and storage.
- To increase the memory on a smart phone, you can add flash memory in the form of microSD cards.
- Users who take many high-resolution photos and videos for professional or personal use can benefit from additional memory.

Figure 8-4: microSD card.

How an Operating System Works (4 of 6)

- **Input** is any data and instructions entered into the memory of a device.
- Input data and instructions can be provided in many ways, including interacting with your touch screen or using a keyboard.
- Once data is in memory, the computer or device interprets it, and the system software executes instructions to process the data into **information.**
- Instructions used for processing data can be in the form of a program or app, commands, or user responses.
- The information is processed into **output.**

Figure 8-5: Screen displays, printers, and speakers are examples of output devices

How an Operating System Works (5 of 6)

- A **buffer** is an area of memory that stores data and information waiting to be sent to an input or output device.
- Placing data into a buffer is called **spooling**.
- An operating system can be single-tasking or multitasking:
  - ✓ A **single-tasking operating system** allows only one program or app to run at a time.
  - ✓ Most operating systems today are **multitasking**. A **multitasking operating system** allows two or more programs or apps to reside in memory at the same time.

How an Operating System Works (6 of 6)

- The one in the **foreground** is the active program, that is, the one you are currently using.
- The other programs running but not in use are in the **background**. The foreground program is typically displayed on the screen, and the background programs are hidden partially or completely behind the foreground program.
- In addition to managing applications, an operating system also manages other processes.
- A **multiuser operating system** enables two or more users to run programs simultaneously.

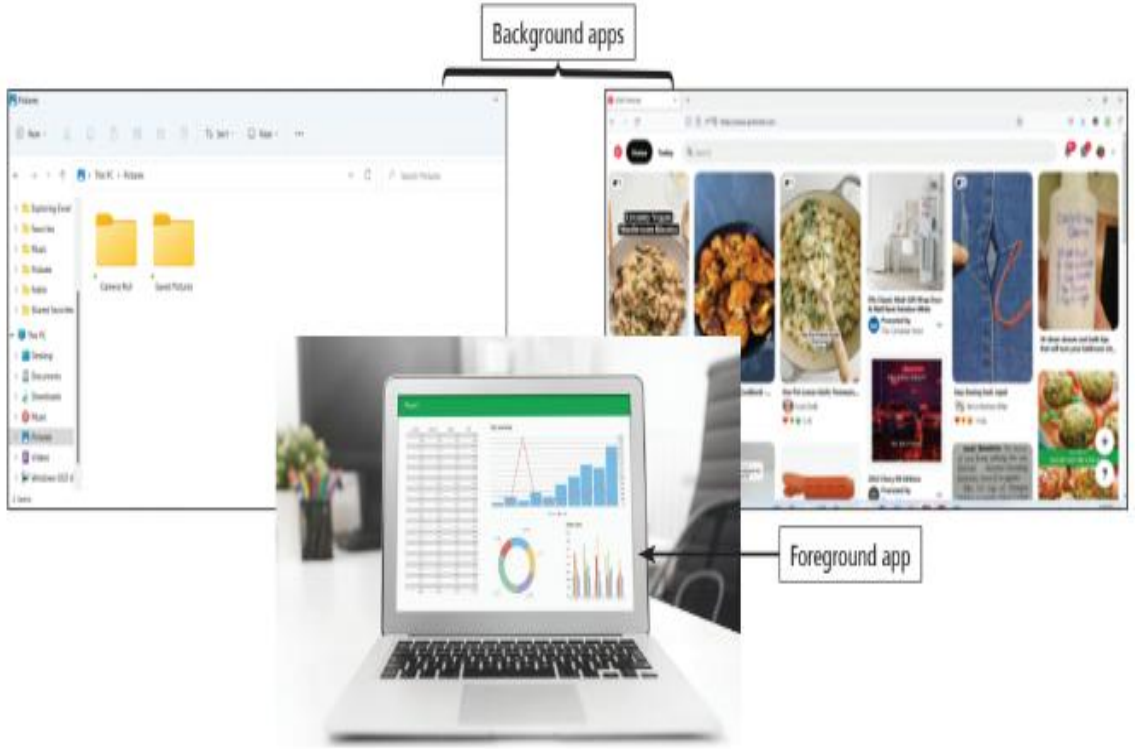


Figure 8-6: The foreground app is on the screen, and the others are in the background

Types of Operating Systems (1 of 11)

- **Servers** do not run the same operating system as tablets or laptops because these computers perform different computing tasks.
- A server, by contrast, is always plugged in and generally remains on all the time, which means its operating system would not need a power-saving feature.
- The three basic categories of operating systems on computers and mobile devices are **desktop, server,** and **mobile**.
- Operating systems, such as UNIX and Linux that function as both desktop and server operating systems sometimes are called **multipurpose operating systems**.

Types of Operating Systems (2 of 11)

- An operating system installed on a single computer is called a **personal computer** (PC) **operating system** or a **desktop operating system**.
- Desktop operating systems are also sometimes called **stand-alone operating systems** or **client operating systems**.
- Certain computers and devices run only those operating systems designed specifically for the **computer** or **device**.
- Examples of widely used desktop operating systems include Windows, macOS, UNIX, Linux, and Chrome OS.

Table 8-2: Examples of operating systems by category.

Category	Name
Desktop	Windows macOS UNIX Linux Chrome OS
Server	Windows Server macOS Server UNIX Linux
Mobile	Google Android Apple iOS Windows (mobile edition)

Types of Operating Systems (3 of 11)

Table 8-3 Examples of Desktop Operating Systems

OS	Used on	Notable features
Microsoft Windows	Desktop computers, laptops, and some tablets	Supports the Cortana virtual assistant, touchscreen input, HoloLens headsets, and built-in apps, such as the Microsoft Edge browser
macOS	Macintosh desktop computers and laptops	Includes the Siri virtual assistant, coordination with Apple mobile devices, and cloud file storage
UNIX	Most computers and devices	Multitasking operating system with many versions as the code is licensed to different developers
Linux	Desktop computers, laptops, and some tablets	Distributed under the terms of a General Public License (GPL), which allows you to copy the OS for your own use, to give to others, or to sell
Chrome OS	Chromebook laptops	Based on Linux, uses the Google Chrome browser as its user interface and primarily runs web apps

Types of Operating Systems (4 of 11)

- The term, **PC** (personal computer) is sometimes used to describe a computer that runs the Windows operating system.
- Windows includes a browser (Microsoft Edge), a cloud storage service (Microsoft OneDrive), and the Windows store for app purchases.
- Features of the latest version of macOS includes a browser (Safari), a cloud storage service (iCloud), and the Mac App Store for app purchases.
- **UNIX** (pronounced "you-nix") is a multitasking operating system developed in the early 1970s by scientists at Bell Laboratories.
- **Linux** (pronounced LINN-uks), introduced in 1991, is a popular multitasking UNIX-based operating system that runs on a variety of personal computers, servers, and devices.

Types of Operating Systems (5 of 11)

- Linux is available in a variety of forms, known as **distributions**.
- **Chrome OS**, introduced by Google, is a Linux-based operating system designed to work primarily with web apps.
- Apps are available through the Chrome Web Store, and data is stored on Google Drive.
- A specialized laptop that runs Chrome OS is called a **Chromebook**, and a specialized desktop that runs Chrome OS is called a **Chromebox**.
- A **server operating system** is a multiuser operating system because it controls a single, centralized server computer that supports many users on networked computers.

Types of Operating Systems (6 of 11)

Table 8-4: Examples of server operating systems.

OS	Used on	Notable features
Windows Server	The server version of Windows	It includes advanced security tools and a set of programs called Internet Information Services that manage web apps and services
macOS Server	Supports all sizes of networks and servers	One unique feature is that it lets authorized users access servers using their iPhones or other Apple devices
UNIX	A multipurpose operating system that can run on a desktop PC or a server	Many web servers, which are Internet computers that store webpages and deliver them to your computer or device, use UNIX because it is a powerful and flexible operating system

Types of Operating Systems (7 of 11)

- Smartphones, tablets, and other mobile devices use a mobile operating system.
- A **mobile operating system** has features similar to those of a desktop operating system but is focused on the needs of a mobile user and the capabilities of the device.
- A mobile operating system works especially well with mobile device features, such as touch screens, voice recognition, and Wi-Fi networks.
- Mobile devices are optimized to perform functions common to mobile users.

Table 8-5: Examples of mobile operating systems.

OS	Used on
Android	Developed by Google based on Linux, and designed to be run on many types of smartphones and tablets
iOS	Runs only on Apple devices, including the iPhone, iPad, and iPod; derived from macOS

Types of Operating Systems (8 of 11)

- An **operating system** has the same role, whether for a desktop or mobile device.
- It manages operations and provides a **user interface**.
- Operating systems enable you to work with apps and to monitor and maintain the functions of the computer or device.

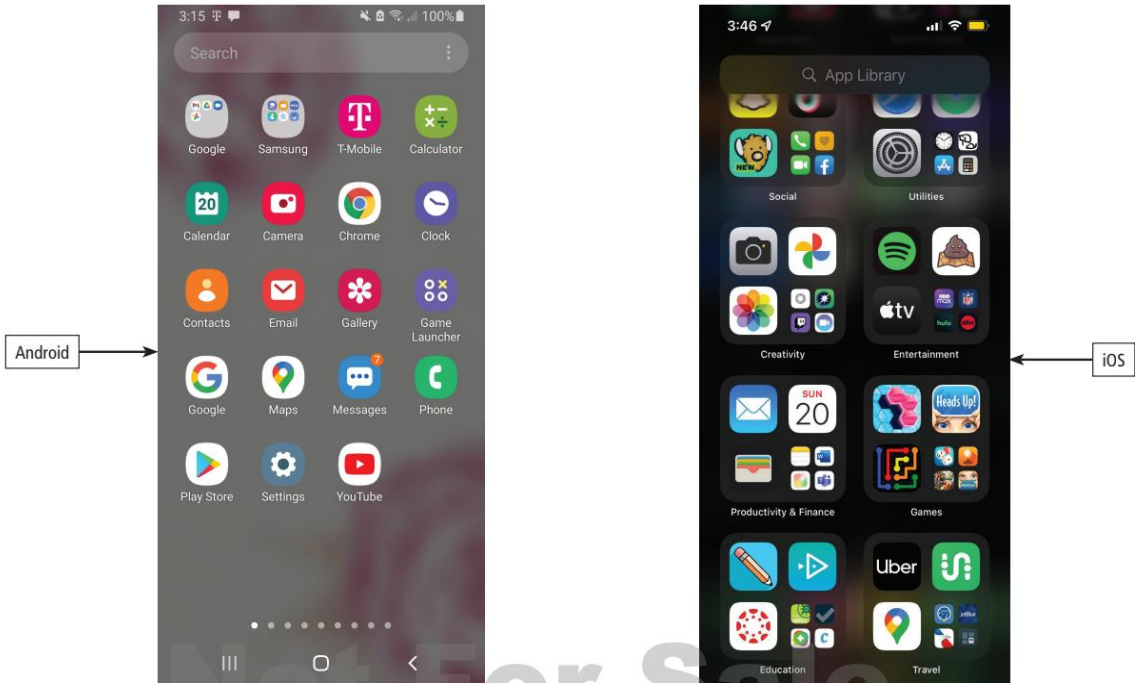


Figure 8-7: Examples of Android and iOS operating systems

Types of Operating Systems (9 of 11)

- Features, such as **icons** (typically used in mobile devices), make the transition between using a mobile device and a computer easier.
- As more computer desktop monitors today are touch-enabled, computer users can take advantage of this feature.
- A **desktop operating system** may use menus, windows, and bars to run apps and to access features within apps.
- A **mobile operating system** may have one program running at a time with others running in the background, or it may provide a means for multiple apps to run simultaneously on the screen.

Types of Operating Systems (10 of 11)

- **Closed-source programs** have standard features and can be customized only by using the operating system's utilities.
- Users can add functionality and sell or give away their versions to others.
- Proponents of open-source programs state that because the code is public, coders can examine, correct, and enhance programs.
- A **device-dependent program** is one that runs only on a specific type or make of computer or mobile device.
- **Proprietary software** is privately owned and limited to a specific vendor or computer or device model.

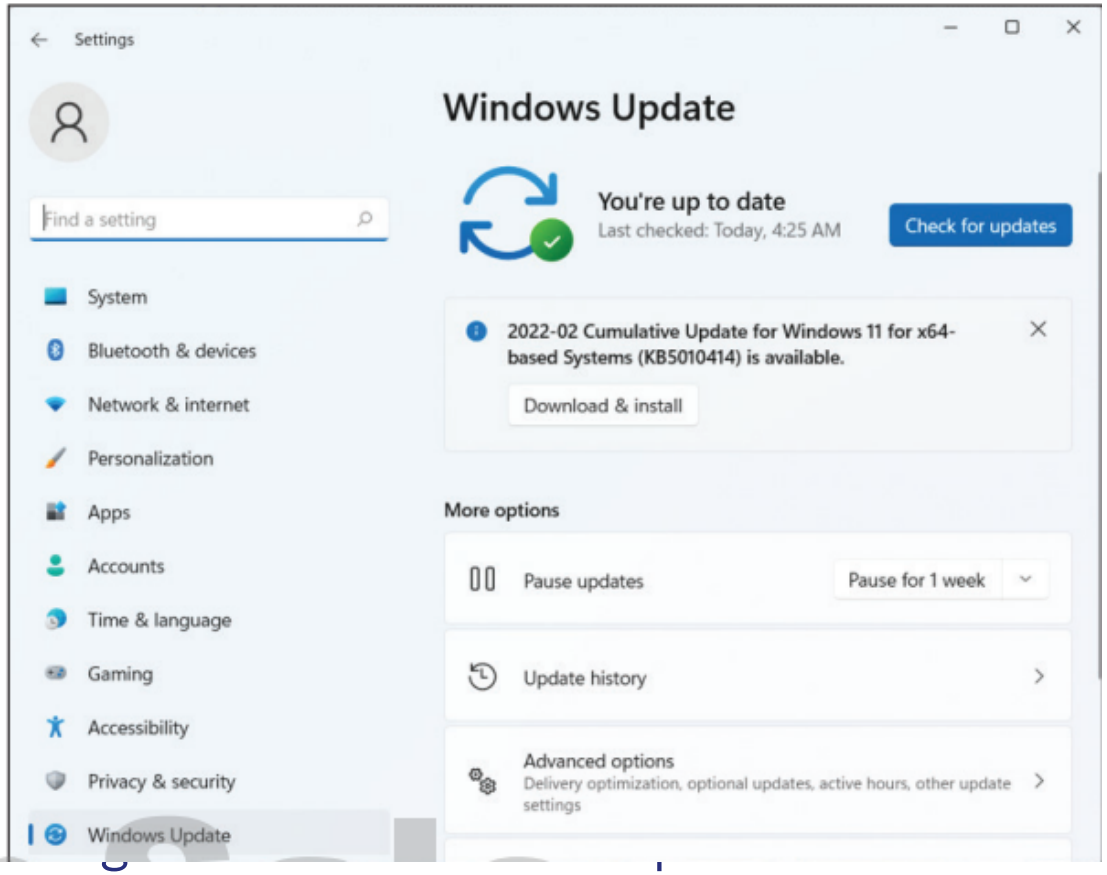
Types of Operating Systems (11 of 11)

- **Mobile operating systems** use technologies such as cellular, Bluetooth, Wi-Fi, GPS, and NFC to communicate with other devices and to connect to the Internet.
- A **cross-platform application** is an application that runs the same way on multiple operating systems.
- Microsoft Windows and macOS are examples of closed-source operating systems.
- **Open-source programs** and **apps** (including operating systems) have no restrictions from the copyright holder regarding modification and redistribution.

Ethics and Issues: Licensing an Operating System (1 of 2)

- As new versions of the operating system are released, users often **upgrade** their existing computers and mobile devices to incorporate features of the new versions.
- The user includes continuity of service (no disruptions because you get cut off from using the software because it is improperly licensed) and security (you have access to the latest updates to know **flaws** or **bugs**).
- An operating system's automatic update feature can be configured to alert users when an update is available or to download and install the update automatically.

Ethics and Issues: Licensing an Operating System (2 of 2)



Manage Files and Folders (1 of 8)

- A **file** is a collection of information stored on your computer, such as a text document, spreadsheet, photo, or song.
- The **file format** determines the type or types of programs and apps that you can use to open and display or work with a file.
- A **file extension** is a three- or four-letter sequence, preceded by a period, at the end of a file name that identifies the file as a particular type of document, such as .docx (Microsoft Word document), or .jpg (a type of graphic file).

Table 8-6: Examples of file extensions.

File type	Extensions
Microsoft Office	.docx (Word), .xlsx (Excel), and .pptx (PowerPoint)
Text file	.txt, .rtf
Webpage	.htm or .html, .xml, .asp or .aspx, .css
Graphics	.jpg, .png, .tif

Manage Files and Folders (2 of 8)

- You can change or view the properties of a file, compress a file to save storage space, move or rename a **file or folder**, and organize your files.
- As **cloud storage** becomes more prevalent and users rely more on their mobile devices, some of these tasks may not be ones you have encountered before.
- Operating systems include many utilities, also called **tools**, that enable you to perform file management tasks.
- Every file has properties, such as its name, type, location, and size.
- File properties also include **metadata**, including the dates when the file was created, modified, and last accessed.

Manage Files and Folders (3 of 8)

- The operating system assigns some properties to files, such as type or format, and updates other properties, such as date, size, and location.
- For example, an image might contain information about the dimensions (size) of the image, while a song or media file might include the artist(s) names.

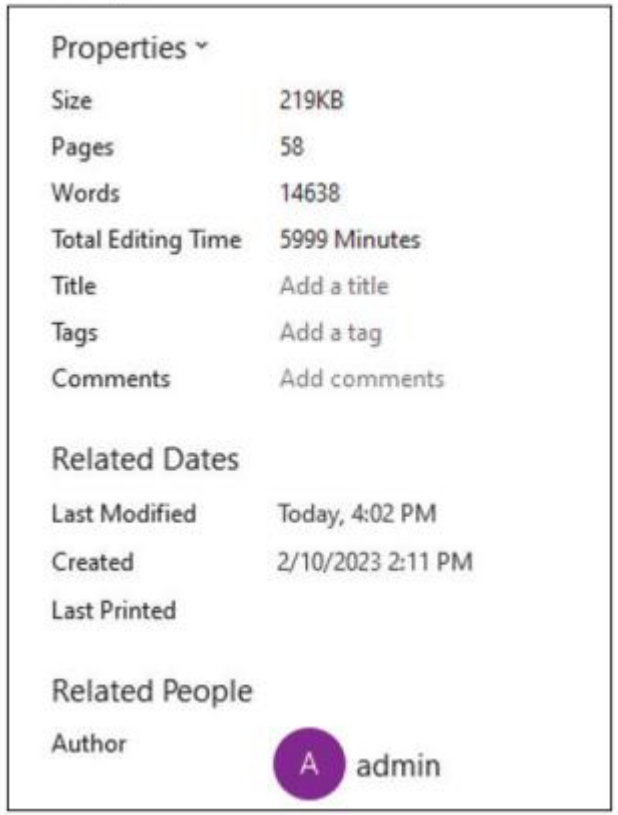


Figure 8-9: Viewing a file's properties.

Manage Files and Folders (4 of 8)

- File size usually is measured in **kilobytes** (KB) (thousands of bytes of data), **megabytes** (MB) (millions of bytes of data), or **gigabytes** (GB) (billions of bytes of data).
- You often need to **compress** files and folders before you share or transfer them.
- **Desktop operating systems** offer utilities to compress and uncompress files.
- When you save a file, you must give it a name that follows rules called **file-naming conventions**.
- Only the colon (:) is a prohibited character in macOS.

Manage Files and Folders (5 of 8)

- A file name should identify the content and purpose of the file, as well as any other information, such as whether the file is a draft or final.
- A folder can only include one file with the same name and of the same type.
- You can have multiple files of the same type with the same name only if they are in different folders.
- To **differentiate a version of a file** without overwriting the original, you could add additional characters such as numbers, the date, or the initials of the person who modified the file.

Manage Files and Folders (6 of 8)

- One method of copying or moving files in Windows is to use the **Clipboard**, which saves the file or folder from the source file or folder until you paste it into the destination file or folder.
- Other operating systems have functions similar to a clipboard, as well as other file management utilities.
- An operating system utility allows you to create new, named folders; choose the location of folders; move files between folders; and create a folder hierarchy that includes subfolders.

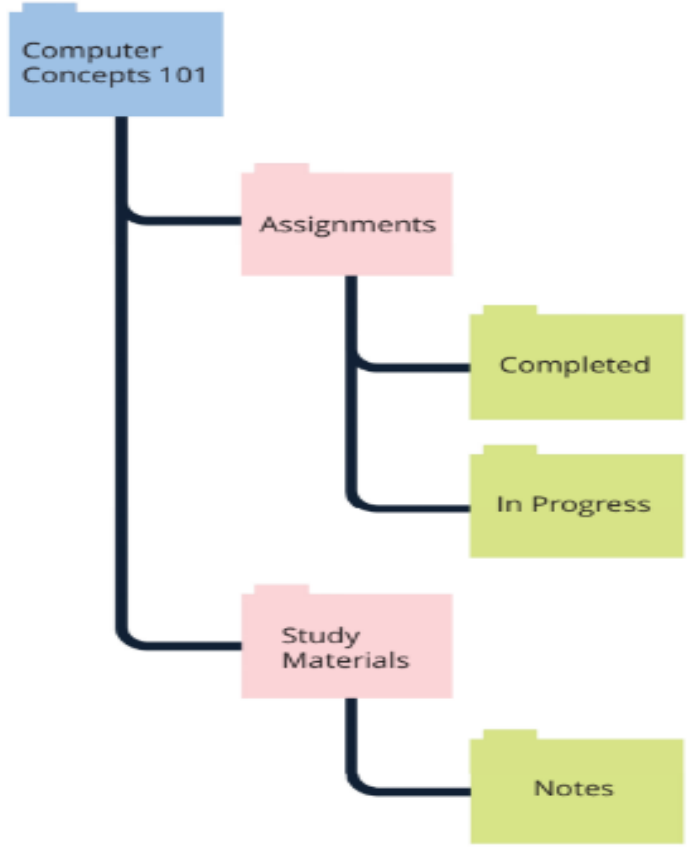


Figure 8-10: Folder hierarchy

Manage Files and Folders (7 of 8)

- A **library** is a special folder that catalogues specific files and folders in a central location, regardless of where the items are actually stored on your device.
- **Libraries** are helpful to find all files of a certain type, no matter where they are located on your computer or device.
- Within your file manager, you can move, copy, and delete folders. Moving or copying a folder affects all the contents of the folder.
- Deleting a folder moves it to the **Recycle Bin** or **Trash folder**, where you can permanently delete it or restore it to its original location if you change your mind.
- You can use a file manager to reorder, move, or navigate between folders.

Manage Files and Folders (8 of 8)

- The Windows file manager is called **File Explorer**, and the macOS file manager is called **Finder**.
- To navigate to a folder, you need to locate it using the search tool or by opening a main folder and then opening subfolders until you get to the folder in which the file(s) you need are located.

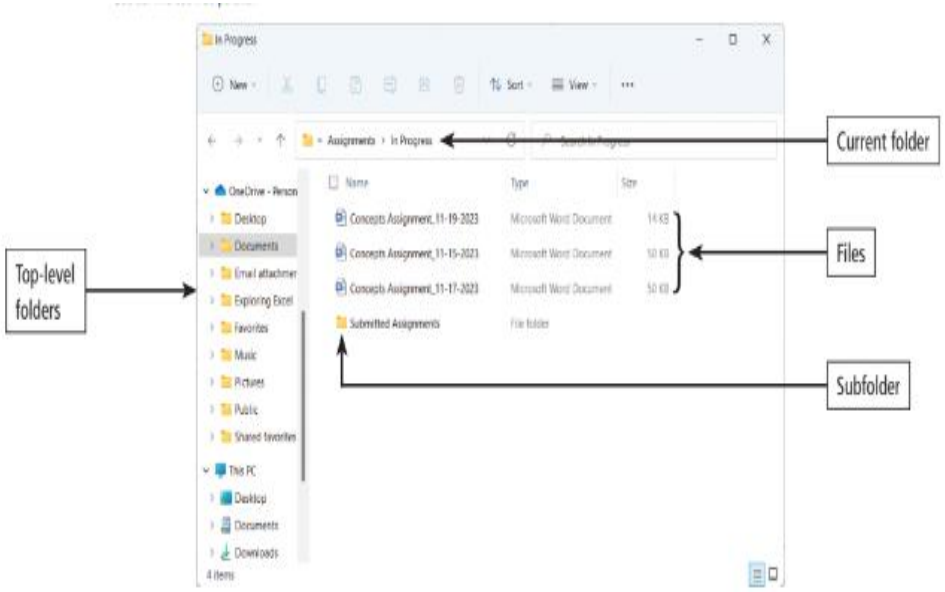


Figure 8-11: Windows file explorer

Use Operating System Management Utilities (1 of 8)

- **Operating systems** provide users with a variety of utilities related to managing their computer and devices and their programs.
- An operating system controls your computer by managing its resources.
- The **operating system** tracks the names and locations of files, as well as empty storage areas where you can save new files.
- To manage **RAM resources**, an operating system keeps track of the apps, processes, and other tasks the system performs.
- You can open your computer or device's version of the task manager to view running programs and see the percentage of RAM being used.
- You can shut down programs and apps in the task manager to free up RAM.

Use Operating System Management Utilities (2 of 8)

Table 8-7: Operating system tools.

Tool	Function
File management	Performs functions related to displaying files; organizing files in folders; and copying, renaming, deleting, moving, and sorting files
Search	Attempts to locate files based on specified criteria
Image viewer/Gallery	Displays, copies, and prints the contents of graphics files
Uninstaller	Removes a program or app, as well as any associated entries in the system files
Disk cleanup	Searches for and removes or archives unnecessary files

Use Operating System Management Utilities (3 of 8)

Table 8-7: Operating system tools. (continued)

Tool	Function
Lock screen	Causes a display's screen to require the user to sign in again if no keyboard or mouse activity occurs for a specified time
File compression	Shrinks the size of a file(s)
Maintenance	Identifies and fixes operating system problems, detects and repairs drive problems, and includes the capability of improving performance
Backup	Copies selected files or the contents of an entire storage medium to another storage location
Power management	Monitors battery usage

Use Operating System Management Utilities (4 of 8)

- Operating systems provide shut down options so that you can exit programs and terminate processes properly.
- Some operating systems have a sleep option to use low power instead of shutting down.
- Sleep stores the current state of open programs and files, saving you time when you resume using your device.
- A common solution for Windows desktop systems is to run a disk cleanup utility, which finds and removes unnecessary files, such as temporary Internet files or files you have marked for deletion.
- Monitoring Performance Operating systems typically include a performance monitor.
- A **performance monitor** is a program that assesses and reports information about various computer resources and devices.
- If a computer is running extremely slowly, for example, the performance monitor may determine that the computer's memory is being used to its maximum.

Use Operating System Management Utilities (5 of 8)

- Operating systems allow you to make adjustments, such as connecting to a network, controlling sounds, allowing or preventing app notifications, changing the brightness or other screen display settings, changing the appearance of the home screen or lock screen, applying a theme to change the look and feel of the operating system elements, and setting lock screen settings.
- You can also use these utilities to uninstall apps, add accounts, and adjust privacy settings.

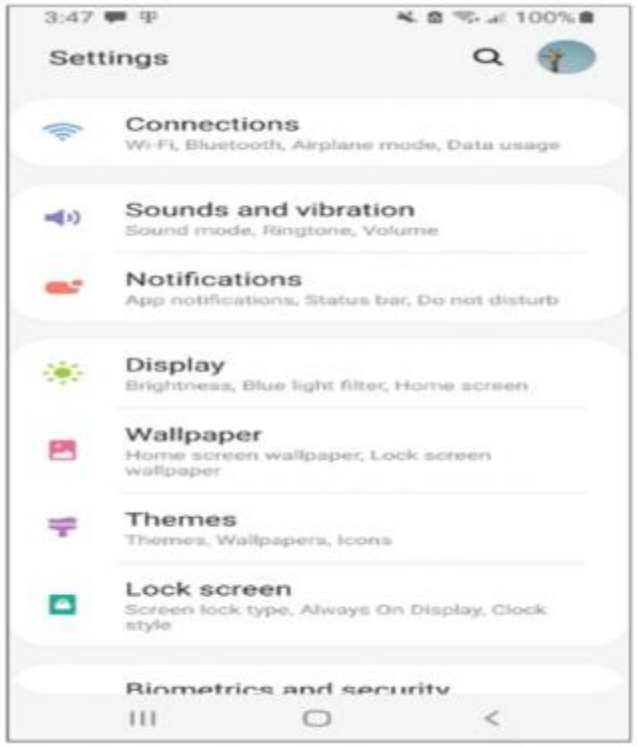


Figure 8-12: Settings for an Android smartphone

Use Operating System Management Utilities (6 of 8)

- The desktop contains icons for programs and files, as well as toolbars, taskbars, menus, and buttons you can use to start programs and apps.
- A notification area displays the date and time, as well as shortcuts to utilities such as audio controls and network connections.
- In any operating system, a window is a rectangular-shaped work area that displays an app or a collection of files, folders, and utilities.

Figure 8-13: macOS desktop

Use Operating System Management Utilities (7 of 8)

- You can use two types of windows on a computer's desktop: a **program window** displays a running program; a **folder window displays** the contents of a folder, drive, or device.

These elements common to most windows include the following:

- The center area of the window displays its contents.
- The title bar at the top displays the name of the app, file, or folder shown in the window.
- On a computer, buttons enable you to maximize (make the window fill the screen), minimize (reduce it to a button on the taskbar without closing it), and resize the window.

Use Operating System Management Utilities (8 of 8)

- Some windows include a ribbon, toolbar, or menu bar that contains text, icons, or images you select to perform actions and make selections.
- Windows can also include vertical and horizontal scroll bars that you drag to display contents currently out of view.
- When you have multiple windows, files, and apps open at a time, the windows car appear side by side or stacked.

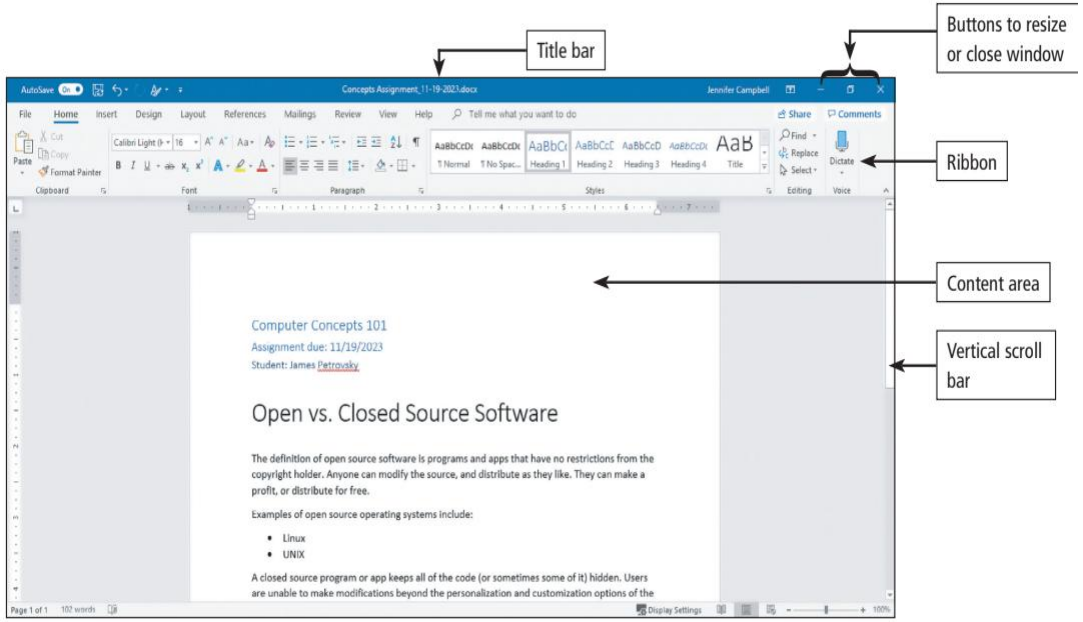


Figure 8-14: Common window elements.

Secure IT: Securing an Operating System (1 of 4)

- **Network administrators**, as well as owners of computers, typically have an administrator account that enables them to access all files and programs, install programs, and specify settings that affect all users on a computer, mobile device, or network.
- Security software must run constantly to protect against new viruses, malware, and spyware attacks.
- Security experts recommend using a **firewall** and configuring it to turn on or off automatically.
- **Automatic updating**: Many people enjoy the convenience offered by allowing these fixes to install automatically instead of continually checking for new files to download.

Secure IT: Securing an Operating System (2 of 4)

- **Spyware and malware detection software**: Because sophisticated spyware and malware threats are emerging at an unparalleled rate, comprehensive spyware and malware detection software is crucial to fend off attacks on the computer or device.
- The operating system is generally scheduled to scan and update when the computer is idle, such as in the middle of the night.
- **Permissions** define who can access certain resources and when they can access those resources.
- **User accounts** protect your computer against unauthorized access. A user account includes information such as a username or ID and a password.

Secure IT: Securing an Operating System (3 of 4)

- A **standard user account** is designed for the everyday user who will be using the computer or device for work or recreation.
- If you want to provide someone temporary access to your computer, you can create a secure guest account that gives access to basic functions.
- A **user account** enables a user to sign into, or access resources on, a network or computer.
- Each user account typically consists of a username and password or PIN, but other methods, such as facial recognition, fingerprints, or a physical security key, can be required for enhanced security.

Secure IT: Securing an Operating System (4 of 4)

- If the user's information matches their security settings, the operating system grants the user access.
- The operating system on a network records successful and unsuccessful sign-in attempts in a file.
- This allows the network administrator to review who is using or attempting to use the computer. The administrators also use these files to monitor computer usage.

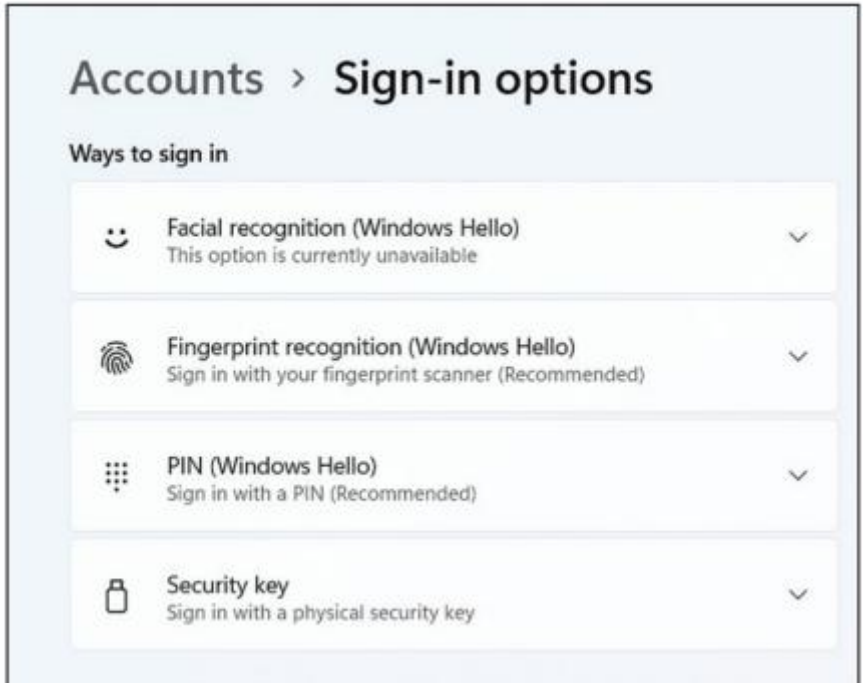


Figure 8-15: Adding security to a user's settings.

How To: Use Virtual Machines (1 of 3)

- A **virtual machine** (VM) enables a computer or device to run another operating system in addition to the one installed.
- To run a virtual machine, you need a program or app that is specifically designed to set up and manage virtual machines.
- The virtual machine runs separately on a section of the hard disk called a "**partition**."

  A partition, also called a **volume**, is a section of a hard drive that functions like a separate drive. You can only access one partition of a hard drive at a time.

How To: Use Virtual Machines (2 of 3)

The following steps describe how to set up a virtual machine:

- Obtain and install an app that creates and runs virtual machines.
- Run the app and select the option to create a new virtual machine.
- Specify the settings for the new virtual machine.
- If necessary, insert the installation media for the operating system you want to run in the virtual machine.
- Run the virtual machine. Follow the steps to install the operating system on the virtual machine.
- When the operating system has finished installing, remove the installation media.
- While the virtual machine is running, if desired, install any apps you want to run.
- When you are finished using the virtual machine, shut down the operating system in the same manner you would shut down your computer.
- Exit the virtual machine software.

How To: Use Virtual Machines (3 of 3)

After you set up the virtual machine, you can use the virtual machine at any time by performing the following steps:

- Run the virtual machine software.
- Select the virtual machine you want to run.
- Click the button to run the virtual machine.
- When you are finished using the virtual machine, shut down the operating system in a similar way to how you would shut down your computer.
- Exit the virtual machine software.