Chapter 5:
System Software:
Operating Systems and Utility Programs
Learning Objectives

• Understand the difference between system software and application software.
• Explain the different functions of an operating system and discuss some ways that operating systems can differ from one another.
• List several ways in which operating systems can enhance processing efficiency.
• Name today’s most widely used operating systems for desktop PCs and servers.
Learning Objectives

• State several devices other than desktop PCs and servers that require an operating system and list one possible operating system for each type of device.

• Discuss the role of utility programs and outline several duties these programs can perform.

• Describe what the operating systems of the future may be like.
Overview

• This chapter covers:
  – Differences between system software and application software
  – Functions of and differences among operating systems
  – Various types of operating systems
  – Functions of and various types of utility programs
  – A look at the possible future of operating systems
System Software and Application Software

- **System software**: Background programs that control a computer system
  - Acts as a mediator between application programs and the computer system’s hardware, as well as between the PC and the user
- **Application software**: Programs that allow a user to perform specific tasks on a computer
  - Word processing, playing a game, preparing taxes, browsing the Web, and so forth
The Operating System

• Operating system: A collection of programs that manage and coordinate the activities taking place within a computer system.
Functions of an Operating System

- Interfacing with users (typically via a GUI)
- Booting the computer
- Configuring devices
  - Device drivers are often needed
  - Plug and Play devices are recognized automatically
- Managing resources and jobs
- File management
- Security
File Management

**FOLDERS AND FILES**

**FOLDERS**
A folder (directory) stores related information and can contain both files and other folders. Folders are designated by a file folder icon.

**FILES**
A file (document) can contain such things as a letter, budget, database, or computer program. Each application program uses unique icons for its files so the user can quickly identify what program is associated with each file.

**WIDELY USED FILE EXTENSIONS**

**DOCUMENTS**

**PROGRAMS**
.exe

**GRAPHICS**
.bmp .tif .tiff .jpg .jpeg .png .gif .pcx .svg .ico

**AUDIO**
.wav .au .mp3 .mp .ra .aiff .mid .aif .aac .wma .ra

**VIDEO**
.mp4 .mp3 .mp .mov .avi .wmv .wma .asf

**COMPRESSED FILES**
.zip .sit .sitx .tar

**FIGURE 5-5**
A sample hard drive organization.

**FIGURE 5-6**
Common file extensions.
Processing Techniques for Increased Efficiency

- **Multitasking:** The ability of an operating system to work with more than one program (task) at one time
  - CPU rotates between tasks
  - Tasks are performed concurrently
  - Multiprogramming: Multitasking with a multiuser operating system

- **Multithreading:** The ability to run multiple threads for a program at one time so that processing is completed faster and more efficiently
  - Thread: Sequence of instructions within a program that is independent of other threads
Processing Techniques for Increased Efficiency

- Multiprocessing: Multiple processors are used in a single computer, usually to process multiple jobs at one time faster than with a single processor
  - Simultaneous processing
  - Used with servers and mainframes; used with desktop PCs now (dual-core processors)
- Parallel processing: Multiple processors are used in a single computer, usually to process a single job faster
  - Simultaneous processing
  - Most often used with supercomputers
- Coprocessing: Utilizing special processors for specialized chores
  - Math and graphics coprocessors
Processing Techniques for Increased Efficiency

**CONCURRENT PROCESSING**
Tasks are performed one right after the other. (multitasking and multithreading)

- Begin word processing document spell-check
- Begin Web page loading
- Perform spreadsheet calculation
- Continue word processing document spell-check
- Finish Web page loading

**SIMULTANEOUS PROCESSING**
Multiple tasks are performed at the exact same time.

- Begin word processing document spell-check
- Perform spreadsheet calculation
- Continue word processing document spell-check
- Begin Web page loading
- Check e-mail
- Finish Web page loading

**FIGURE 5-7**
Concurrent vs. simultaneous processing.

**CONCURRENT VS. SIMULTANEOUS PROCESSING**
With concurrent processing, tasks are performed one right after another; with simultaneous processing, multiple tasks are performed at exactly the same time. The tasks shown here are more typical of a desktop PC; typical tasks for multiprocesssing and parallel processing computers would be more complex.
Processing Techniques for Increased Efficiency

• Memory management: Optimizing the use of main memory (RAM)
  – Virtual memory: Memory-management technique that uses hard drive space as additional RAM
Processing Techniques for Increased Efficiency

- Buffering and spooling: Used with printers and other peripheral devices
  - Buffer: area in RAM or on the hard drive designated to hold input and output on their way in or out of the system
  - Spooling: placing items in a buffer so they can be retrieved by the appropriate device when needed

![Image of a print queue](image_url)
Differences Among Operating Systems

- Command line vs. graphical user interface (GUI)
  - Most operating systems use GUI today
Differences Among Operating Systems

- Personal vs. server operating system
  - Personal operating system: designed to be installed on a single PC
  - Server operating system: designed to be installed on a network server
    - Client PCs still use a personal operating system
    - Server operating system controls access to network resources
  - Many operating systems come in both versions
- Mobile and embedded operating systems also exist
2. The client software provides a shell around your desktop operating system. The shell program enables you to communicate with the server operating system, which is located on a network computer called a file server.

3. When you request a network activity, such as printing a document using a network printer, your application program passes the job to your desktop operating system, which sends it to the client shell, which sends it on to the server operating system, which is located on the network server.

4. The server operating system then sends your job to a computer known as a print server, which lines up your job in its print queue and prints the job when its turn comes.

1. When you log on to the network, you gain access to network resources, such as application programs, shared data files, and printers. Once logged on, you can access files, print documents, and more.
Differences Among Operating Systems

- Types of processors supported
  - Desktop, mobile, server, etc.
  - 32-bit or 64-bit PCs
    - 64-bit PCs can address more RAM
- Support for other technologies
  - New types of buses
  - Virtualization
  - Power-saving features
  - Sometimes support is discontinued, such as for older ports and buses
Operating Systems for Desktop PCs and Servers

• Most PCs today run Windows, Mac OS, or Linux

• DOS: Older operating system
  – PC-DOS: Created originally for IBM microcomputers
  – MS-DOS: used with IBM-compatible PCs
  – DOS traditionally used a command-line interface
  – Can enter DOS commands at the Windows Command Prompt
## DOS

**COMMAND PROMPT**
Using the Windows command prompt window, users can issue DOS commands to their computers.

**FIGURE 5-13**
DOS. Even though DOS has become technologically obsolete, some PCs still use it.

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### DOS COMMANDS

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>DESCRIPTION</th>
<th>EXAMPLE</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPY</td>
<td>Copies individual files</td>
<td>COPY TODO.DOCX F:</td>
<td>Copies the file TODO.DOCX located in the current directory on the current storage medium to the F drive.</td>
</tr>
<tr>
<td>DIR</td>
<td>Displays the names of files on a storage medium</td>
<td>DIR F:</td>
<td>Displays the names of the files stored on the storage medium located in the F drive.</td>
</tr>
<tr>
<td>DEL</td>
<td>Deletes individual files</td>
<td>DEL F: HOMEWORK.DOCX</td>
<td>Deletes the file HOMEWORK.DOCX from the storage medium located in the F drive.</td>
</tr>
<tr>
<td>REN</td>
<td>Renames individual files</td>
<td>REN SAM.JPG BILL.JPG</td>
<td>Changes the name of the file SAM.JPG located in the current directory to the current storage medium to BILL.JPG.</td>
</tr>
<tr>
<td>CD</td>
<td>Changes to a new directory</td>
<td>CD HOMEWORK</td>
<td>Changes the current directory to HOMEWORK, located one level down from the current location on the current storage medium.</td>
</tr>
<tr>
<td>FORMAT</td>
<td>Prepares a storage medium for use, erasing what was there before</td>
<td>FORMAT F:</td>
<td>Formats the storage medium located in the F drive.</td>
</tr>
</tbody>
</table>
Windows

• Windows: The primary PC operating system developed by Microsoft Corporation
  – Windows 1.0 through Windows 3.x: Operating environments for DOS, not full-fledged operating systems
  – Windows 95 and Windows 98: Used a similar GUI to the one used with Windows 3.x
  – Windows NT (New Technology): first 32-bit version of Windows designed for high-end workstations and servers
Windows

• Windows, cont.
  – Windows Me (Millennium Edition): designed for home PCs, improved home networking and a shared Internet connection
  – Windows 2000: replaced Windows NT; was geared towards high-end business workstations and servers, support for wireless devices
  – Windows XP: Replaced both Windows 2000 and Windows Me
    • Based on Windows NT technology
    • More stable and powerful than earlier versions of Windows
    • Newest features related to multimedia and communications
Windows

• Windows Vista: Most recent version of Windows
  – Features the Aero visual interface
    • Transparency and animations
    • Live Thumbnails
  – The Vista Start menu is more streamlined
  – Built-in security features
  – Improved networking and multimedia
  – Additional features
    • Sidebar, Instant Search, etc.
  – Hardware requirements for Vista have increased over earlier versions of Windows
  – Four editions (Home Basic, Home Premium, Business, and Ultimate)
Windows Vista

- **NEW PROGRAMS**: Include multimedia, security, and collaboration programs.
- **AERO INTERFACE**: Features translucent, glass-like windows and 3D effects.
- **SIDEBAR**: Contains the user’s selected gadgets.
- **WINDOWS**: Contain programs, icons, documents, and so forth.
- **TASKBAR TOOLBAR**: Used to launch programs.
- **START MENU**: Includes a search box to search for documents, programs, and Web sites.
- **SEARCHES**: Can be saved for later use.
- **ICONS**: Represent programs, folders, documents, and other items that can be opened with the mouse.

*Figure 5-14* Windows Vista.
Windows

- Windows Server: Server version of Windows
  - Windows Server 2008: Most recent version
  - Includes a variety of services
    - Web platform
    - Support for virtualization
    - New security tools
    - Streamlined management tools

- Windows Home Server: New operating system based on Windows Server
  - Provides services for a home network
  - Provides access to shared files
  - Can back up all devices on the network automatically
Mac OS

- Mac OS: Proprietary operating system for computers made by Apple Corporation
  - Based on the UNIX operating system; originally set the standard for graphical user interfaces
  - Mac OS X Leopard: Most recent personal version
  - Mac OS X Server: Most recent server version
  - Includes
    - Support for 64-bit processors
    - Safari Web browser
    - New features like Time Machine, Stacks, Quick Look, Boot Camp, etc.
Mac OS

QUICK LOOK
Shows previews of files without opening them.

STACK
Contains a collection of documents stored on the dock by the user.

WINDOWS
Contain programs, icons, documents, and so forth.

ICONS
Represent programs, folders, documents, or other items that can be opened with the mouse.

DOCK
Contains the user's Stacks and commonly used icons.

FIGURE 5-16
Mac OS X Leopard.
UNIX

- UNIX: Operating system developed in the late 1960s for midrange servers and mainframes
  - Many variations of UNIX are in use today
  - Multiuser, multitasking operating system
  - More expensive, requires a higher level of PC knowledge, and tends to be harder to install, maintain, and upgrade than most other operating systems
  - “UNIX” initially referred to the original UNIX operating system, now refers to a group of similar operating systems based on UNIX
  - Single UNIX Specification: A standardized UNIX environment
Linux

- Linux: Version (flavor) of UNIX available without charge over the Internet
  - Increasingly being used with PCs, servers, mainframes, and supercomputers
  - Is open-source software: has been collaboratively modified by volunteer programmers all over the world
  - Originally used a command line interface, most recent versions use a GUI
  - Strong support from mainstream companies, such as Sun, IBM, HP, and Novell
  - Used on PCs, mainframes, and consumer appliances
  - Growing integration between Linux and other operating systems is a recent development
Linux

ICONS
Represent programs, folders, documents, or other items that can be opened with the mouse.

FIGURE 5-17
Linux. Linux is a rapidly growing alternative to Windows and Mac OS.

MULTITASKING
Buttons can be used to switch between open windows.

ELCOT
Success Story

Overview
The Electronics Corporation of Tamil Nadu (ELCOT) has been procuring hardware and software for the various departments of the Government of Tamil Nadu since 1977. The organization is also involved in consultancy, implementation, support and training, helping to meet the state's ambitious governance objectives. ELCOT is the implementing agency for the prestigious Tamil Nadu State Wide Area Network Project (TN-SWAN) at a cost of $40 million. ELCOT is also in the process of commissioning the State's data center and disaster recovery center.

Challenge
As a provider of IT procurement services to the Government of Tamil Nadu, ELCOT's main objective is to offer the best possible IT solutions at the lowest price - maximizing the return on investment (ROI).

SUSE, Linux Enterprise Desktop: A Cost-effective and Flexible Desktop Alternative

WINDOWS
Contain programs, icons, documents, and so forth.
Netware and Solaris

- **NetWare**: Widely used operating system for PC-based networks
  - Developed by Novell
  - Competes directly with the server versions of Windows, Mac OS, and Linux
  - Newest version (NetWare 6.5) incorporates Open Enterprise Server

- **Solaris**: UNIX-based operating system developed by Sun Microsystems for Sun computers
  - Can run on desktop systems and servers, as well as on some supercomputers
  - Latest version—**Solaris 10**—is designed to run across a variety of platforms in a safe, efficient, and stable manner
Operating Systems for Handheld PCs and Mobile Devices

- Windows Embedded: Designed for nonpersonal computer devices, such as cash registers and consumer electronic devices
  - Windows Automotive and Microsoft Auto for cars
- Windows Mobile: Designed for handheld PCs, smart phones, and other mobile devices
- Palm OS: Designed for Palm handheld PCs
- BlackBerry Operating System: Designed for BlackBerry devices
- Embedded Linux: Designed for handheld PCs, mobile phones, GPS devices, and other mobile devices
- Symbian OS: Designed for use with smart phones
Larger computers sometimes use operating systems designed solely for that type of system.

IBM’s z/OS and i/5OS operating systems are designed for their servers and mainframes.

Windows, UNIX, and Linux, are also used with both mainframes and supercomputers.

Often a group of Linux PCs are linked together to form what is referred to as a Linux supercluster supercomputer.
Utility Programs

- Utility program: Type of software that performs a specific task, usually related to managing or maintaining the computer system.
- Many utilities are built into operating systems (for finding files, viewing images, backing up files, etc.).
- Utilities are also available as stand-alone products and as security suites.

**FIGURE 5-19**
Utility suites. Utility suites contain a number of related utility programs.
File Management Programs

- File management programs: Enable the user to perform file management tasks, such as:
  - Looking at the contents of a PC or storage medium
  - Creating folders
  - Copying, moving, and renaming files and folders
  - Deleting files and folders
  - File management program in Windows is Windows Explorer
Using Windows Explorer

The Organize button is used to create new folders and copy files and folders.

Click a drive or folder icon in the left pane to display its contents in the right pane.

A dark arrow sign means all folders inside this item are displayed.

A clear arrow sign means this item contains folders that are not displayed.

The Navigation pane contains Favorite Links and the Folders list.

Use the Back button to go to the previous location.

Use the Views button to change how the items in the right pane are displayed.

Use the Address bar to specify the desired drive and folder.

Enter keywords to search for a folder or file meeting the criteria you supply.

Double-click a folder to open it.

Double-click a document to open it in its associated program.

**FIGURE 5-20**
Using Windows Explorer to look at the contents of a PC.
Using Windows Explorer

1. Open the drive and folder where the file to be copied or moved is located, and then select the file.

2. Click the Organize button and select *Copy* to copy the file to the Clipboard (select *Cut* to move the file to a new location instead).

3. Open the drive and folder where the file should go.

4. Click the Organize button and select *Paste* to copy the file from the Clipboard to the current location.

5. The file appears in the new location.

*FIGURE 5-21*
Using Windows Explorer to copy and move files.
Utility Programs

- Search tools: Designed to search for files on the user’s hard drive
  - Windows Vista includes new search tools
- Diagnostic programs: Evaluate your system and make recommendations for fixing any errors found
- Disk management programs: Diagnose and repair problems related to your hard drive
- File compression programs: Reduce the size of files so they take up less storage space on a storage medium or can be transmitted faster over the Internet
  - Both zip and unzip files
  - WinZip (Windows users) and Stuffit (Mac users)
File Compression Programs

**FILE SIZE**
The 25 files, totalling over 20 MB, are zipped into a single 7 MB .zip file.

**COMPRESSION RATIOS**
Certain image file formats (such as .tif) compress more than others (such as .jpg, which is already in a compressed format). Documents containing text fall somewhere in between.

![WinZip - UC 12 Chapter 5.zip](image)

**FIGURE 5-23**
File compression.
File compression can be used with both image and text files, although image files generally compress more efficiently.
Utility Programs

• Uninstall utilities: Remove programs from your hard drive without leaving bits and pieces behind
  – Uninstall capabilities are built into most operating systems
  – Uninstall utility programs are also available as stand-alone programs
  – Sometimes an uninstall option is included in a program’s folder when that program is originally installed
  – Important to properly uninstall programs, not just delete them

• Cleanup utilities
  – Designed to delete temporary files
Utility Programs

• Backup and recovery utilities: Make the backup and restoration process easier
  – Backup: Duplicate copy of data or other computer content
  – Good backup procedures are critical for businesses and individuals
    • Individuals should back up important documents, e-mail, photos, home video, etc.
    – Store backup data on a CD or DVD, second hard drive, flash memory drive, or upload to the Internet
    – Back up your entire PC once all programs have been installed, so your system can be restored to that configuration.
Backup Programs

1. After starting the backup program, select the desired backup medium.

2. Select the hard disks to be backed up.

3. Select the types of files to be backed up.

4. If desired, schedule automatic backups.

5. The files are backed up on the specified storage medium.

FIGURE 5-24
Using Windows Backup.
Utility Programs

- Security programs: Protect computers and users
  - Antivirus programs
  - Antispyware programs
  - Firewalls
  - Many are included in Windows and other operating systems
  - Discussed in detail in Chapter 9
The Future of Operating Systems

- Will continue to become more user-friendly
- Will eventually be driven primarily by a voice interface
- Likely to continue to become more stable and self-healing
- Will likely continue to include improved security features and to support multiple processors and other technological improvements
- May be used primarily to access software available through the Internet or other networks
Summary

• System Software vs. Application Software
• The Operating System
• Operating Systems for Desktop PCs and Servers
• Operating Systems for Handheld PCs and Mobile Devices
• Operating Systems for Larger Computers
• Utility Programs
• The Future of Operating Systems