

# **Chapter 5**

**System Software  
Operating Systems  
and Utility Programs**

## Introduction

It is well known that all computers require software in order to operate and perform basic tasks. This chapter focuses on one type of software that is needed for the computer to translate the user's command into a form the computer can understand, to open and close other programs, to manage the stored files, and to locate and setup new hardware as it is added to the computer. This type of software is called system software. It should be noted that system software runs in the background at all times to launch other software when needed and to make the user able to use the computer.

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The chapter starts with a look on the differences between system software and application software. System software consists of two types; the operating system (the primary component) and the utility programs. The functions of operating systems are discussed together with the differences between them. Then, the chapter explores the utility programs which support functions for the operating system such as allowing to manage files, to perform maintenance on the computer, to check the computer for viruses, or uninstall a program. Finally, the chapter introduces a look at what the future operating system may hold.

### The objectives of this chapter:

#### After completing this chapter, you will be able to:

- Understand the differences between system software and application software.
- Explain the different functions of an operating systems.
- List the differences between some operating systems.
- Name today's most widely used operating systems for PCs and servers.
- Discuss the role of various types of utility programs.
- Describe what the operating systems of the future might be like.

Note

## System software VS Application software

Generally, software is categorized into two types: system software and application software. The following is a brief description for the two types.

- **System software:**

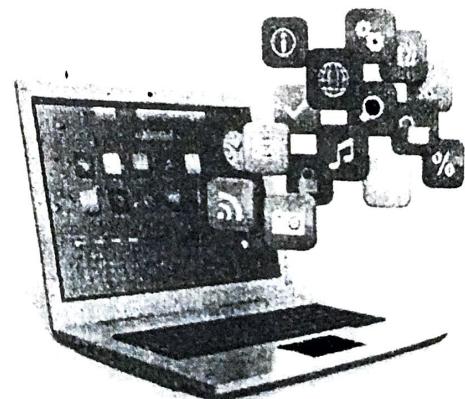
System software consists of the operating system and utility programs that control the computer system and allow the user to use the computer. The roles of the system software are:

- Enabling the computer to boot.
- Launching application programs.
- Facilitating important jobs such as transferring files from one storage medium to another.
- Configuring the computer to work with the hardware connected to it.
- Managing files on the hard disk.
- Protecting the computer from unauthorized use.



- **Application software:**

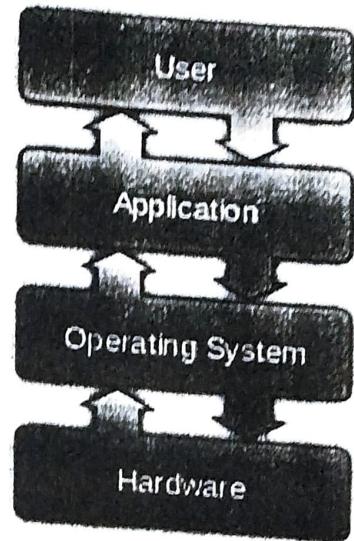
Application software includes all the programs that allow the user to perform specific tasks on the computer. From the task that can be performed by application programs are writing a report, preparing an invoice, viewing a Web page, listening to a sound file, playing a game, preparing a financial statement, designing an electronic circuit, etc...



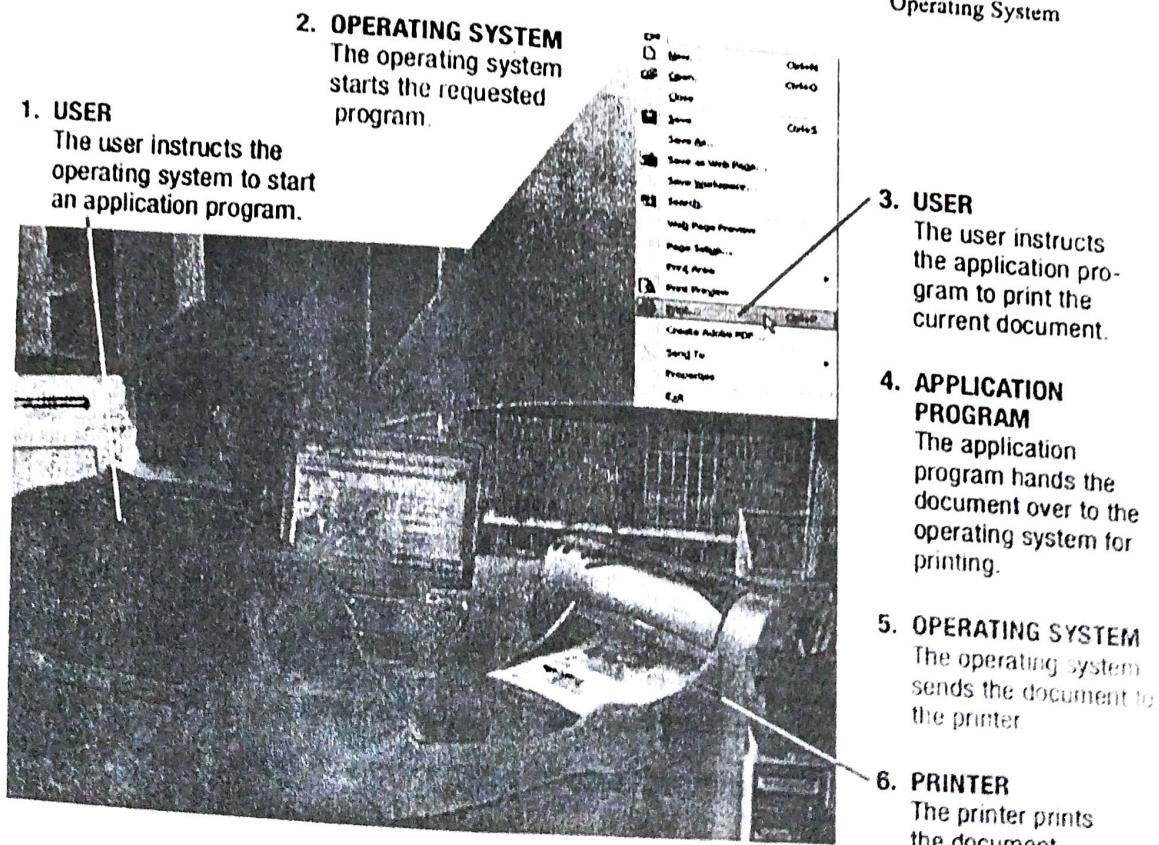
# The Operating System (OS)

Operating system: is a collection of programs that manage and coordinate the activities taking place within a computer system.

One of the main functions of the OS is that it interfaces the user with application programs to facilitate the use of the computer. For example, the following Figure shows the steps of printing a document written by a word processing application program. Here, when the user issues the print command to the application program, it hands the document to the operating system which sends the file to the printer and runs the printing program.



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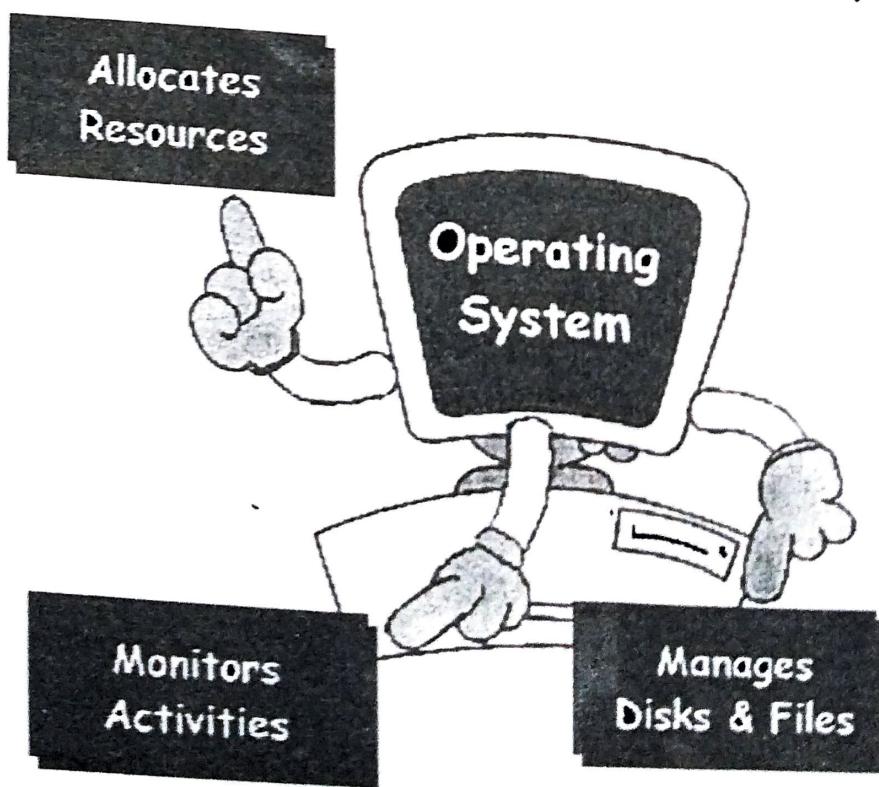


The intermediary role of the operating system

Note:

## Functions of an Operating System

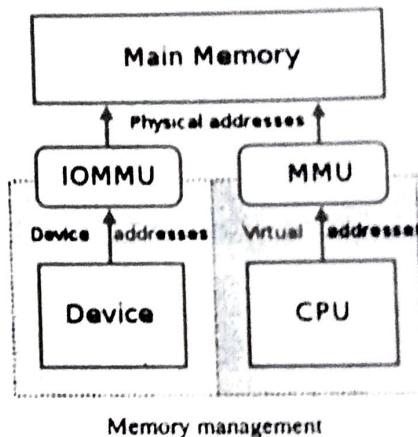
- Interfacing with users (typically via a GUI).
- Booting the computer.
- Configuring devices .
  - Device drivers are often needed.
  - Plug and Play devices are recognized automatically.
- Managing and monitoring resources and jobs.
- File management.
  - Filename rules vary with each operating system.
  - File extensions are often added automatically.
- Security .
  - Protect access to resources via *passwords* or other security procedures.
  - Many operating systems include a *firewall*.
  - Security capabilities are often upgraded via *security patches*.



Note: refer to the original book for details.

## Main-Memory Management

- Memory is a large array of words or bytes, each with its own address. It is a repository of quickly accessible data shared by the CPU and I/O devices.
- For program to be executed it must be mapped to absolute addresses and loaded into memory.
- Main memory is a volatile storage device.
- It loses its contents in the case of system failure.
- The operating system is responsible for the following activities in connections with memory management:
  - Keep track of which parts of memory are currently being used and by whom.
  - Decide which processes to load when memory space becomes available.
  - Allocate and deallocate memory space as needed.

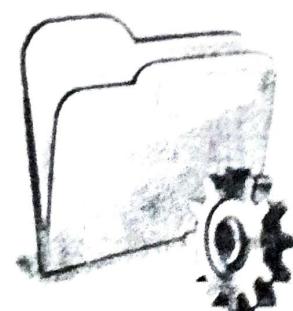


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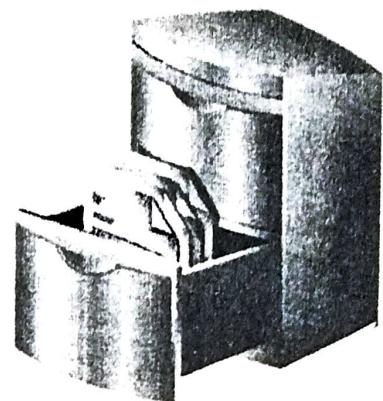
## File Management

- A file is a collection of related information defined by its creator. Commonly, files represent programs (both source and object forms) and data.
- The operating system is responsible for the following activities in connections with file management:
  - File creation and deletion.
  - Directory creation and deletion.
  - Support of primitives for manipulating files and directories.
  - File backup on stable (nonvolatile) storage media.



## Secondary-Storage Management

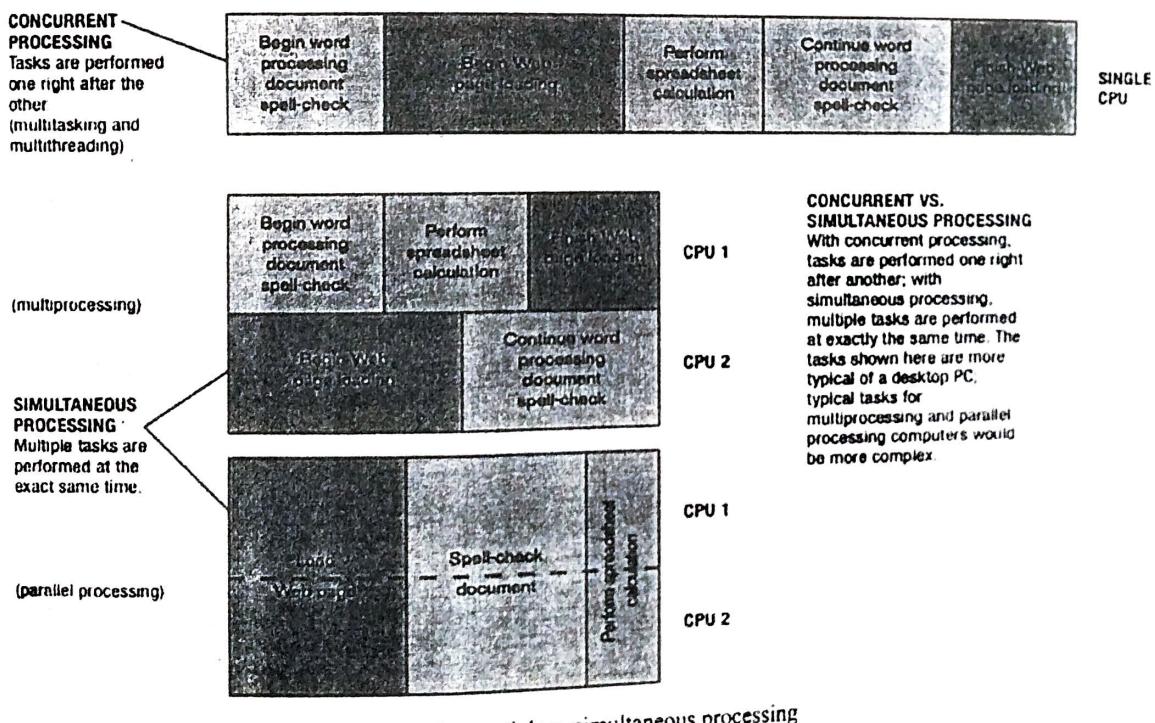
- Since main memory (primary storage) is volatile and too small to accommodate all data and programs permanently, the computer system must provide secondary storage to back up main memory.
- Most modern computer systems use disks as the principle on-line storage medium, for programs and data, most **programs are stored on it until it loaded into memory.**
- The operating system is responsible for the following activities in connection with disk management:
  - Free space management.
  - Storage allocation.
  - Disk scheduling.

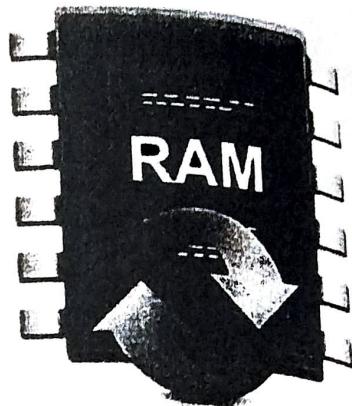


## Processing Techniques for Increased Efficiency

- **Multitasking:** the ability of an operating system to work with more than one program (task) at one time.
  - CPU rotates between tasks (concurrent processing).
- **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.
  - Concurrent processing.

- **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).
- **Co processing:** utilizing special processors for specialized chores (e.g. math or graphics coprocessor).



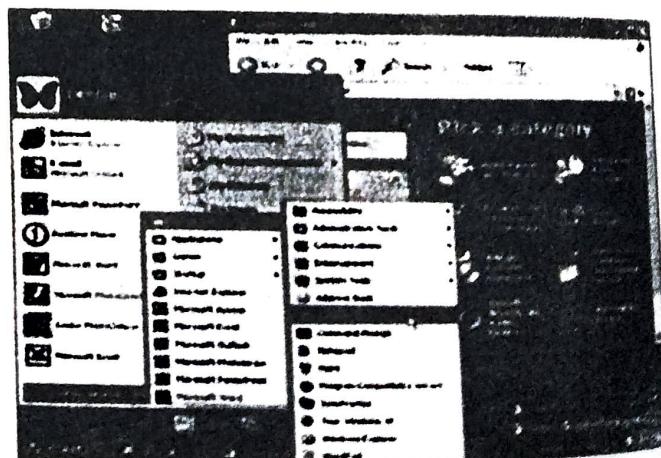


## **Differences among Operating Systems:**

- **Command line vs. graphical user interface (GUI).**
    - Most operating systems use GUI today.

# COMMAND LINE INTERFACE

**Commands are entered using the keyboard.**

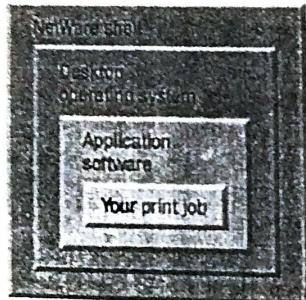


## **GRAPHICAL USER INTERFACE**

**Icons, buttons, menus, and other objects are selected with the mouse to issue commands to the PC.**

- **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.
- There are also mobile and embedded operating systems
- Most operating systems are designed for a specific type of processors (desktop CPUs or server CPUs, for instance).
- Also usually designed for either 32-bit or 64-bit PCs.

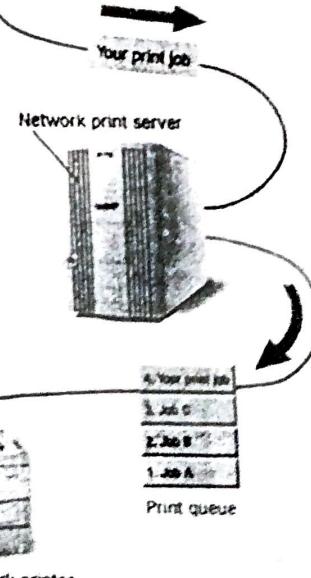
2. NetWare provides a shell around your desktop operating system. The shell program enables you to communicate with NetWare, which is located on a network computer called a file server.



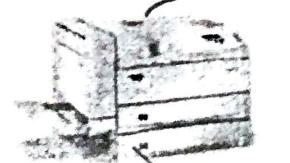
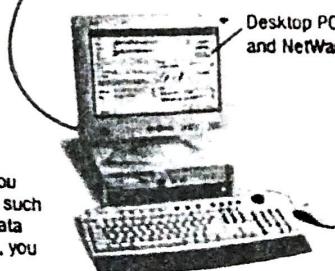
3. When you request a network activity, such as printing a document using a network printer, your application program passes the job to your desktop operating system, which sends it to the NetWare shell, which sends it on to NetWare, which is located on the network server.



4. NetWare 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, and more.



How operating systems are used in a network environment

# Operating Systems for Desktop PCs and Servers

- Operating systems are usually designed for use on either:
  - Desktop PCs (personal operating systems).
  - Network servers (network operating systems).
- Many operating systems are available in both personal and server versions.
- Older operating system is DOS; most PCs today run Windows, Mac OS, or Linux.

## ➤ DOS:

- The operating system designed for and widely used on early IBM and IBM-compatible PCs .
- There were two primary forms of DOS:
  - **PC-DOS:** created originally for IBM microcomputers.
  - **MS-DOS:** used with IBM-compatible PCs.
- DOS traditionally used a command-line interface.
- Not widely used today.

```
C:\>DIR
C:\>Dir c:\mydocs\11
C:\>My Documents\11
Volume in drive C has no label.
Volume Serial Number is 1234 1234
Directories of C:\My Documents
Volume in drive C has no label.
Volume Serial Number is 1234 1234
Directories of C:\My Documents
          0 DIR     02-19-93 12:24p
          0 File    02-19-93 12:24p No Pictures
My Pictures 0 DIR     02-19-93 12:24p No Pictures
My Videos   0 DIR     02-19-93 12:24p No Videos
My Web     0 DIR     02-19-93 12:24p No Web
Fax Template.dos 20,418 02-21-93 12:24p Fax Template.dos
Company logo.jpg 12,367 02-21-93 12:24p Company logo.jpg
Digital sig.bmp 90,894 02-01-93 12:24p Digital signature Harley.bmp
My Basic   0 DIR     02-21-93 12:24p My Basic
My Books   0 DIR     02-21-93 12:24p My Books
My Music   0 DIR     02-21-93 12:24p My Music
My Work   0 DIR     02-21-93 12:24p My Work
Total size 122,527 bytes
Free space 32,944,471 bytes
C:\>Documents\11
```

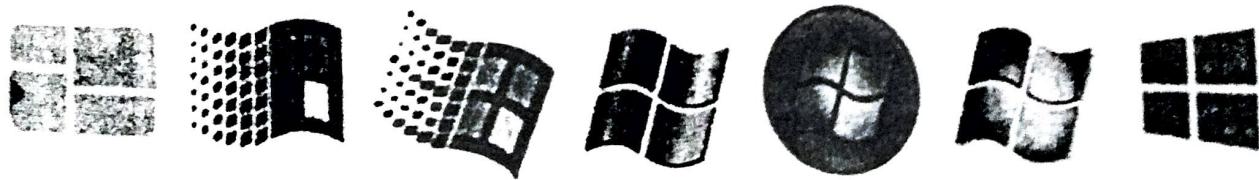
COMMAND	DESCRIPTION	EXAMPLE	EXPLANATION
COPY	Create a copy of file	COPY BOSS.FWK BOSS1	Creates a copy of the file BOSS.FWK and renames it to BOSS1
DIR	Display the contents of directory	DIR A:	Shows the contents of the current directory
DEL	Delete a file	DEL A.DOLLAR	Deletes the file A.DOLLAR
REN	Rename a file or directory	REN SAM.BILL SAM1.BILL	Changes the name of the file SAM.BILL to SAM1.BILL
CD	Change directory	CD HOMEWORK	Changes the current directory to HOMEWORK
FORMAT	Format a disk	FORMAT A:	Formats the disk A:

## ➤ 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:** both used a similar GUI to the one used with Windows 3.x.
- **Windows 98 Second Edition (SE):** update to Windows 98, released in 1999; still an installed base of older PCs running Windows 98 SE.
- **Windows NT (New Technology):** first 32-bit version of Windows designed for high-end workstations and servers.
- **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.

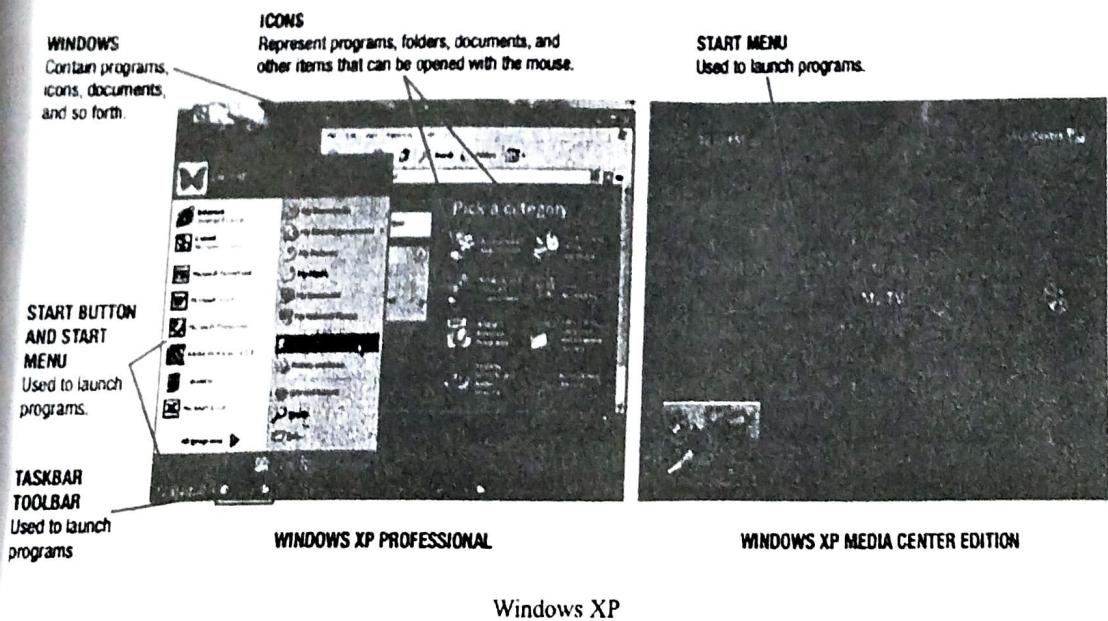
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Windows 1   Windows 3.1   Windows 95   Windows XP   Windows Vista   Windows 7   Windows 8  
1985      1992      1995      2001      2006      2009      2012

Note

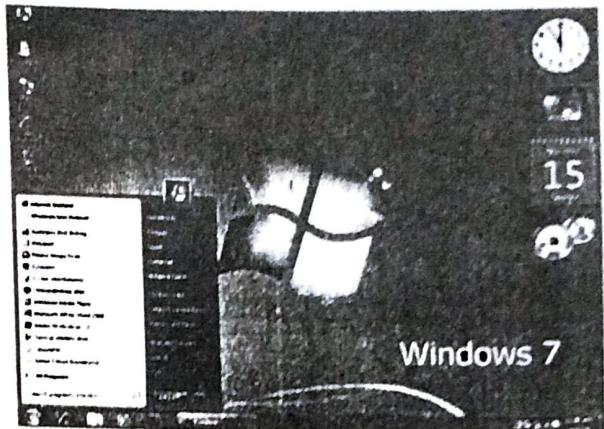
- **Windows XP:** latest personal version of Windows; designed to replace both Windows Me and Windows 2000.
  - Based on Windows NT technology.
  - More stable and powerful than earlier versions of Windows; built on the Windows 9x kernel.
  - Newest features are related to multimedia and communications.
  - Available in five versions plus *Starter Editions* in other languages.



- **Windows Server 2003:** most recent version of Windows designed for server use.
  - Builds on the server version of Windows 2000 but is designed to be easier to deploy, manage, and use.
  - Incorporates Microsoft .NET technology for connecting information, people, systems, and devices.
- **Windows Vista:** upcoming version of Windows (known before as Longhorn) to replace Windows XP.

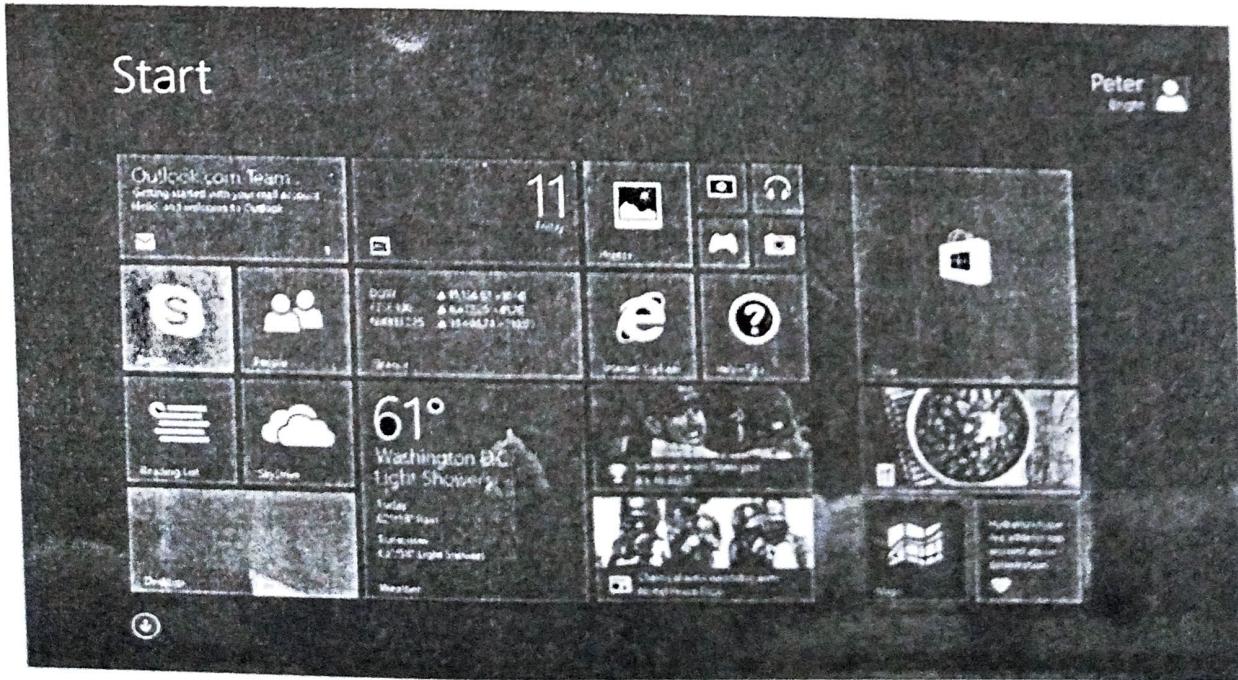
- **Windows 7:** is a personal computer operating system developed by Microsoft. It is a part of Windows NT family of operating systems. Development of Windows 7 started as early as 2006 under the codename “Blackcomb.”

Windows 7 was released to manufacturing on July 22, 2009, and became generally available on October 22, 2009.



Windows 7

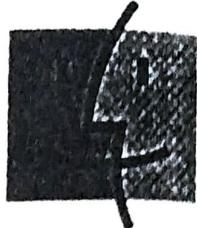
- **Windows 8:** is a personal computer operating system developed by Microsoft as part of the Windows NT family of operating systems. Development of Windows 8 started before the release of its predecessor, Windows 7, in 2009.
  - **Windows 8.1:** (codenamed Blue) is an upgrade for Windows 8.



Windows 8.1

## ➤ Mac OS:

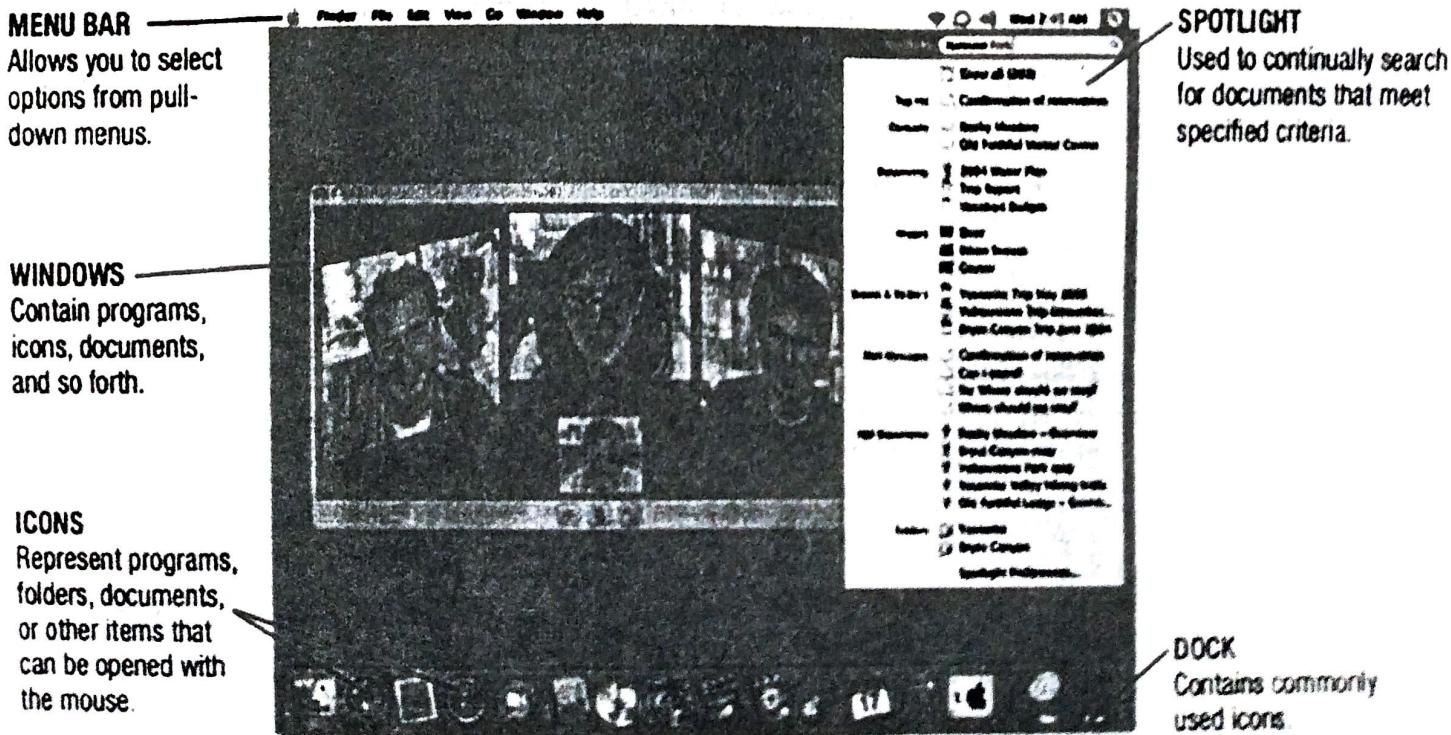
proprietary operating system for computers made by Apple Corporation.



- Based on the UNIX operating system; originally set the standard for graphical user interfaces.
- Mac OS X: most recent version of the operating system used on Apple computers; latest personal and server versions are version 10.4, known as Tiger.

# Mac OS

Mac OS logo



Mac OS

## ➤ **UNIX:**

operating system developed in the 1970s for midrange servers and mainframes; many variations of this operating system are in use today.

- Multi user, multitasking.
- 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.



UNIX logo

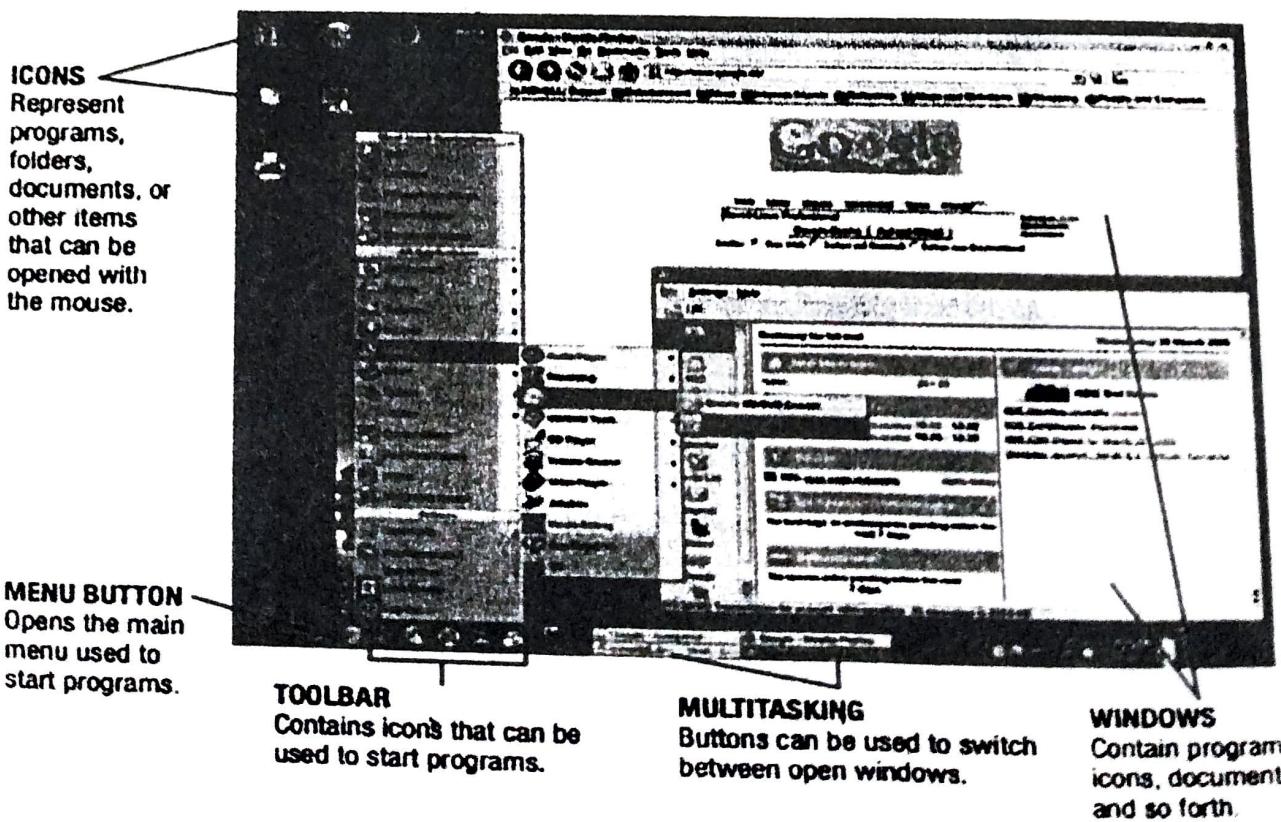
## ➤ Linux:

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.



Linux logo



Windows interface (GUI)

## ➤ NetWare:

widely used operating system for PC-based networks.

- Developed by Novell.
- Competes directly with the server versions of Windows and Mac OS.
- Provides a shell around the users' local desktop operating systems so they can interact with network resources .



NetWare logo

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## ➤ 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.



Solaris logo



Solaris

Note

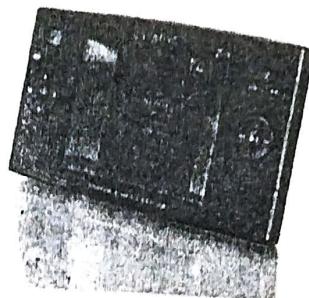
## Operating Systems for Handheld PCs and Mobile Devices

- Embedded and mobile versions of Windows.
  - **Windows Embedded:** family of operating systems based on Windows, designed for nonpersonal computer devices, such as cash registers and consumer electronic devices.
  - **Windows Mobile:** family of operating systems based on Windows and designed for handheld PCs, smart phones, and other mobile devices.
- **Palm OS:** designed for Palm handheld PCs.
- **Embedded Linux:** designed for handheld PCs and mobile devices.
- **Symbian OS:** designed for use with smart phones.

Note:



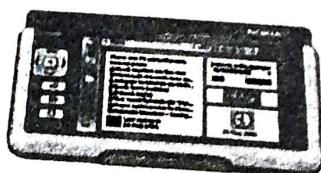
HANDHELD PC



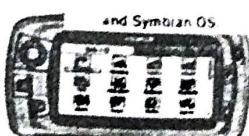
PORTABLE MEDIA PLAYER



A HANDHELD PC RUNNING PALM OS



A WI-FI INTERNET TABLET RUNNING EMBEDDED LINUX



A SMART PHONE RUNNING SYMBIAN OS

## Operating Systems for Larger Computers

- Larger computers sometimes use operating systems designed solely for that type of system.
- IBM's z/OS, OS/390, and MVS operating systems are designed for their various 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.

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## Utility Programs

It is a 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.

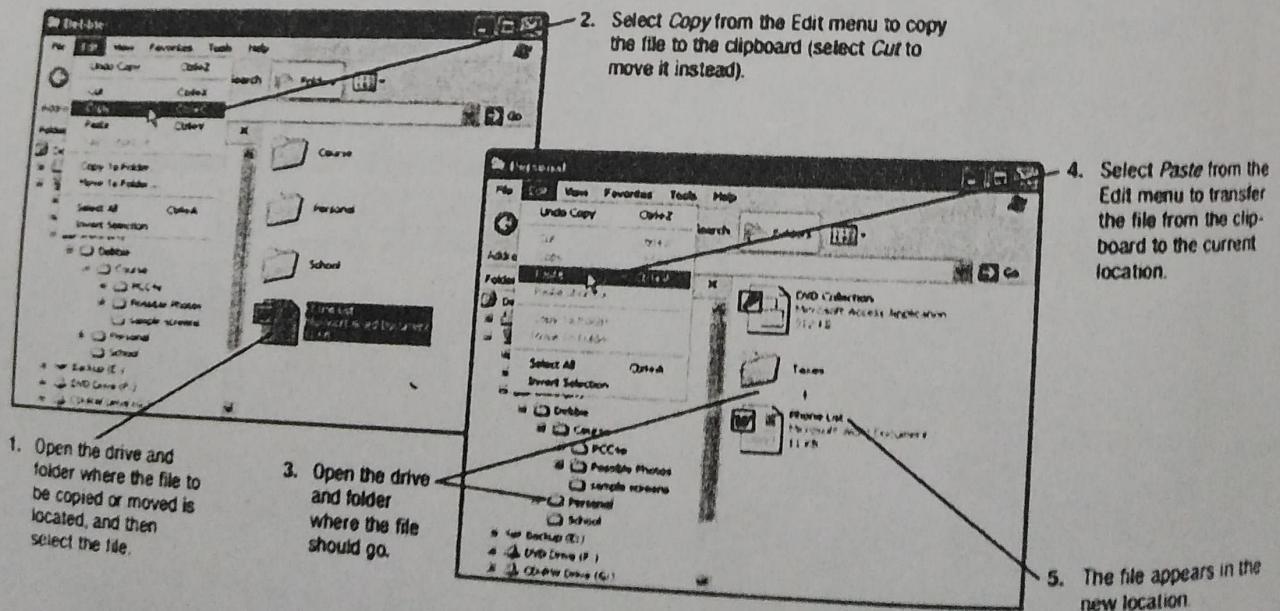
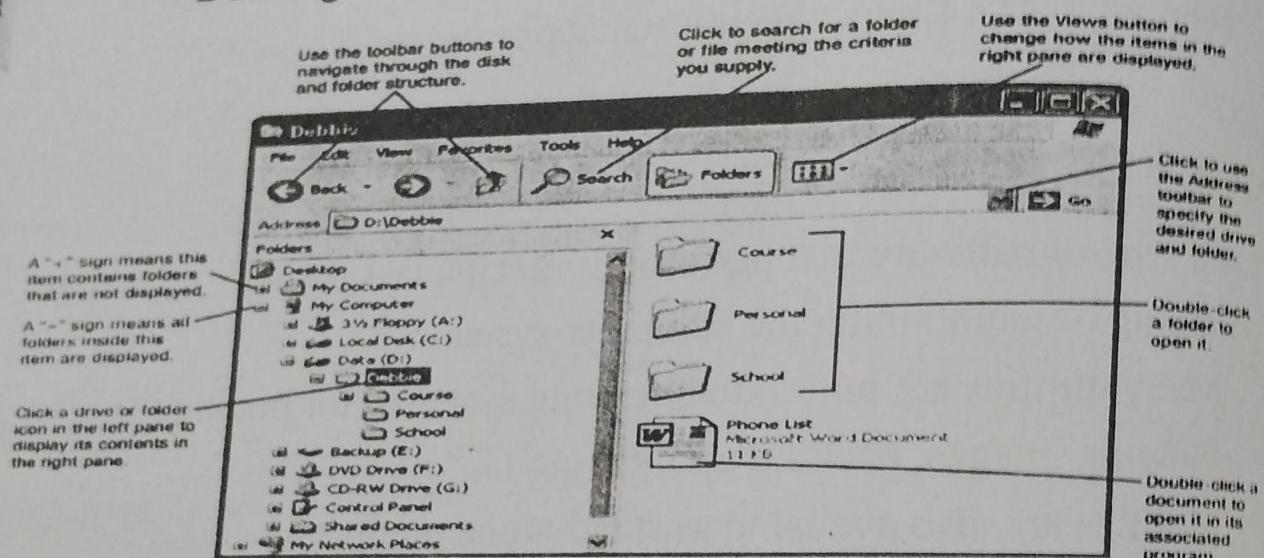
Note:   
1. Norton Utilities  
2. AVG  
3. PC TuneUp 2000  
4. System Mechanic

## File Management Programs

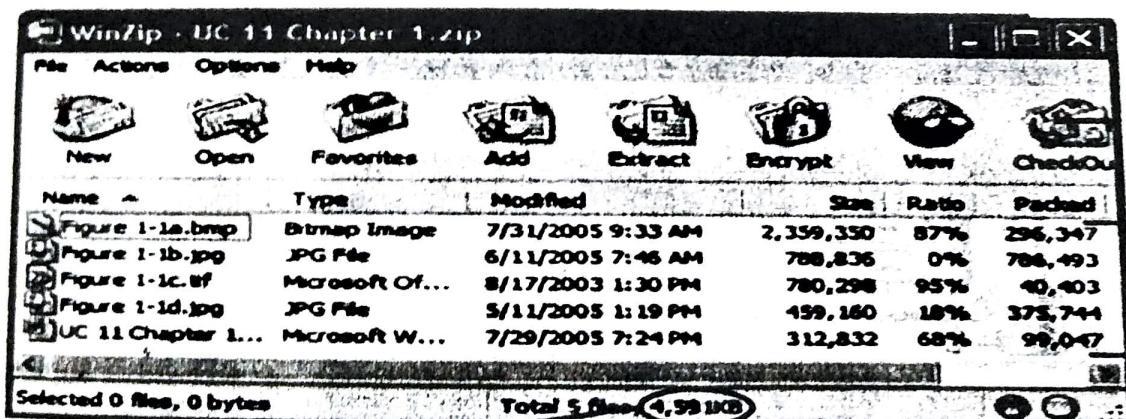
- File management programs: utility programs that enable the user to perform file management tasks, such as:
  - Looking at the contents of a PC or storage medium.
  - Creating folders.
  - Copying, moving, and renaming files and folders.
  - Deleting files and folders.

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Note:



- **Search tools:** utility programs designed to search for files on the user's hard drive.
- **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.
  - Required to both compress (zip) and decompress (unzip) files.
  - Common programs are WinZip (Windows users) and Stuffit (Mac users).



### COMPRESSION RATIOS

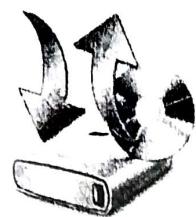
Certain image file formats (such as .bmp and .tif) compress more than others (such as .jpg, which is already in a compressed format). Text files (such as .doc) fall somewhere in between.

### FILE SIZE

The 5 files, totalling over 4.5 MB, are zipped into a single 1.6 MB .zip file.

File compression programs

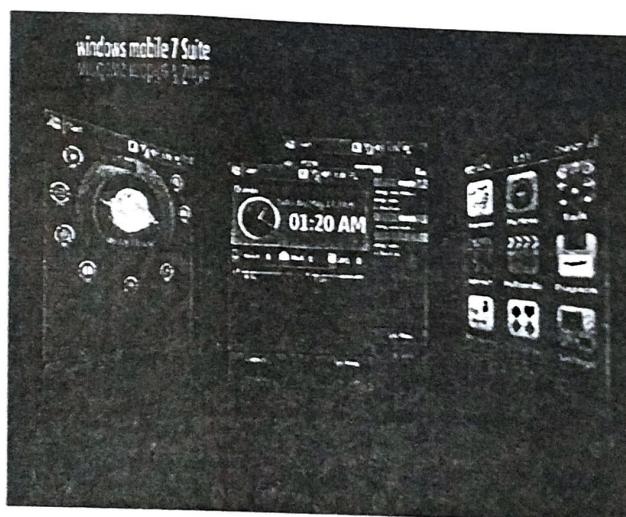
- **Uninstall utilities:** remove programs from your hard drive without leaving bits and pieces behind.
  - Uninstall capabilities are built into most operating systems.
  - Uninstall utility programs are also available as stand-alone programs.
  - Sometimes an uninstall option is included in a program's folder when that program is originally installed.
  - Important to properly uninstall programs, not just delete them.
- **Backup and recovery utilities:** programs to make the backup and restoration process easier.
  - **Backup:** a duplicate copy of data or other computer content
  - Good backup procedures are critical for businesses and individuals.
  - Backup data can be stored on a CD or DVD, second hard drive, flash memory drive, or uploaded to the Internet
  - It is a good idea to backup your entire PC once all programs have been installed, so your system can be restored to that configuration. The Windows *System Restore* program exists for that purpose.
- **Security programs:**
  - Antivirus programs can protect against getting a virus in the first place, as well as detect and remove viruses.
  - Antispyware programs can detect and remove spyware programs installed on your PC.
  - Firewalls can protect against someone accessing your PC via the Internet.



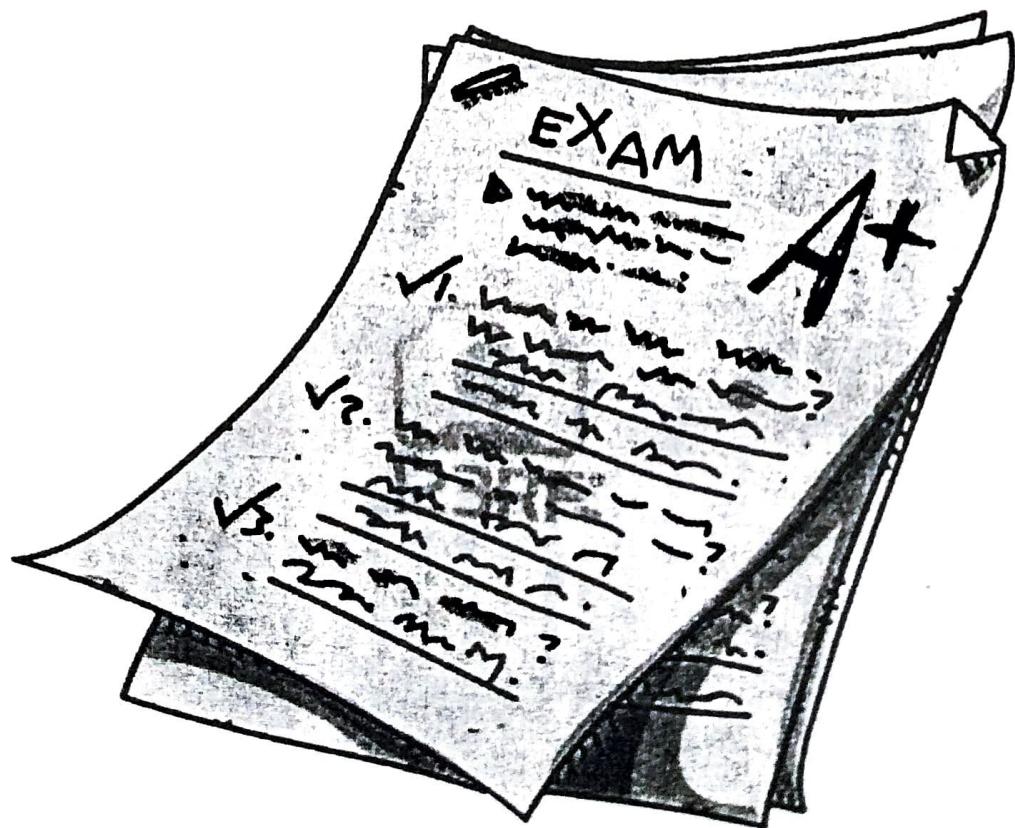
## The future of operating systems

It is expected that the OSs will continue to become more user friendly and may be driven primarily by voice, eyes and brain signals. Also, OSs will continue to be more stable and self healing (repairing) or restoring system files as needed. In addition, it is expected to continue to include security and technological improvements.

It is expected also that the OSs will enable users to access software available on the internet or other networks, instead of accessing software on the local computer.



# Exercises



**1- Match each key term on the left with the definition on the right that best describes it.**

Key term matching	Description
a. Android	1- A duplicate copy of data or other computer content for use in the event that the original version is destroyed.
b. backup	2- A Linux-based operating system designed for mobile phones and developed by a group of companies that includes Google.
c. device driver	3- A memory-management technique that uses hard drive space as additional RAM.
d. kernel	4- A program that enables an operating system to communicate with a specific hard-ware device.
e. multitasking	5- A type of software that performs a specific task, usually related to managing or maintaining the computer system.
f. operating system	6- The capability of an operating system to run more than one program at one time.
g. spooling	7- The essential portion, or core, of an operating system.
h. utility program	8- The main component of system software that enables the computer to manage its activities and the resources under its control, run application programs, and interface with the user.
i. virtual memory	9- The primary personal computer operating system developed by Microsoft Corporation.
j. Windows	10- The process of placing items in a buffer so the appropriate device (such as a printer) can retrieve them when needed.

**2- Circle T if the statement is true, F if the statement is false.**

- a). T    F Windows 7 is an example of an operating system.
- b). T    F Most operating systems today use a command line interface.
- c). T    F Mobile devices, such as portable digital media players and mobile phones, typically require an operating system.
- d). T    F Windows Explorer is an operating system designed for mobile phones.
- e). T    F Windows Mobile is a versatile operating system designed to be used on a variety of computer types, such as mainframes, servers, personal computers, and mobile phones.

**3- Write the best answer in the space provided.**

- a). ..... refers to the ability of an operating system to have more than one program open at one time.
- b). ..... is an operating system that is available for free over the Internet.
- c). To decrease the size of a file, a(n) ..... utility program can be used.
- d). To guard against losing your data if a computer problem occurs, you should ..... your data files on a regular basis.