Unit 10 □ Operating System

10.0 Objectives

The objectives of the Unit are to :
- Explain the concept of OS
- Trace the evolution of OS
- Discuss process of booting a computer
- Outline general aspects of MS-WINDOWS OS
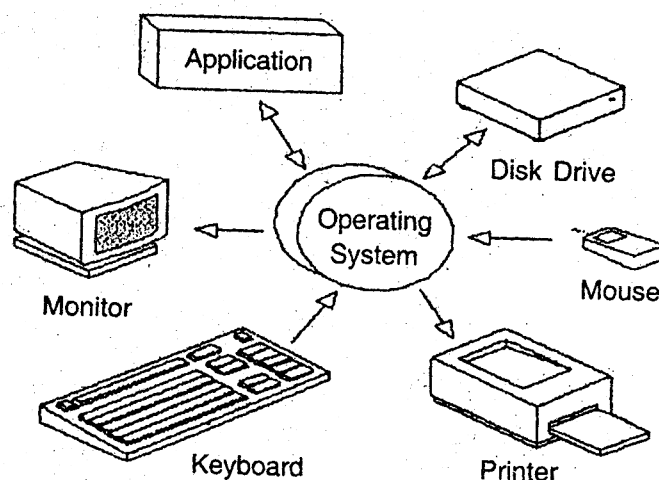
10.1 Operating Systems

10.1.0 Introduction

Operating System (OS) is the basic software that controls a computer. There are many types of operating systems, the complexity of which varies depending upon what type of functions are provided, and what the system is being used for. Some systems are responsible for managing many users on a network. Other operating systems do

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not manage user programmes at all. These are typically found in hardware devices like petrol pumps, airplanes, video recorders, washing machines and car engines.

10.1.1 Definition

It is the master control programme that runs the computer. The first programme loaded when the computer is turned on, its main part, the "kernel," resides in memory at all times. Application programmes "talk to" the operating system for all user interfaces and file management.


The operating system has six major functions :

1. User Interface : All arez graphics based today, the user interface includes the windows, menus and method of interaction between user and the computer. Prior to the Mac, Windows and Motif (Unix) interfaces, all interaction was based on commands entered by the user. Operating systems may support optional interfaces (different shells) for different functionality and appearance.

2. Job Management : Job management controls the order and time in which programmes are run and is more sophisticated in the mainframe environment where scheduling the daily work has always been routine. In a desktop environment, batch files can be written to perform a sequence of operations which can be scheduled to start at a given time.

3. Task Management : Multitasking, which is the ability to simultaneously execute multiple programmes, is available in all operating systems today. Critical in the mainframe and large server environment, applications can be prioritized to run faster or slower depending on their purpose. In the desktop world, multitasking is necessary just for keeping several applications open at the same time so user can bounce back and forth among them.

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4. Data Management : Data management keeps track of the data on disk, tape and optical storage devices. The application programme deals with data by file name and a particular location within the file. The operating system's file system knows where that data are physically stored (which sectors on disk) and interaction between the application and operating system is through the programming interface. Whenever an application needs to read or write data, it makes a call to the operating system.

5. Device Management : Device management controls peripheral devices by sending those commands in their own proprietary language. The software routine that knows how to deal with each device is called a "driver." The operating system contains all the drivers for the peripherals attached to the computer. when a new peripheral is added, that device's driver is installed into the operating system.

6. Security : Multi-user operating systems provide password protection to keep unauthorized users out of the system. Large operating systems also maintain activity logs and accounting of the user's time for billing purposes. They also provide backup and recovery routines for starting over in the event of a system failure.

The following figure presents the architecture of a typical operating system and shows how an OS succeeds in presenting users and application programmes with a uniforms interface without regard to the details of the underlying hardware.
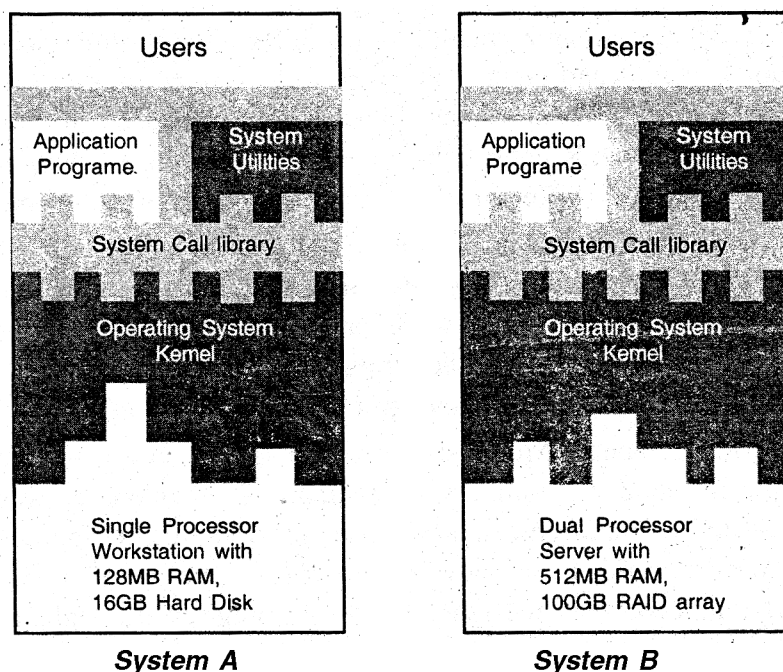
System A

System B

10.1.2 Evolution of Operating System

Historically operating systems have been tightly related to the computer architecture, it is good idea to study the history of operating systems from the architecutre of the computers on which they run. Operating systems have evolved through a number of distinct phases or generations which corresponds roughly to the decades.

First Generations (1940s)

The earliest electronic digital computers had no operating systems. Machines of the time were so primitive that programmes were often entered one bit at time on rows of mechanical switches (plug boards). Programming languages were unknown (not even assembly languages). Operating systems were unheard of.

Second Generation (1950s)

By the early 1950's the routine had improved somewhat with the introduction of punch cards. The General Motors Research Laboratories implemented the first operating systems in early 1950's for their IBM 701. The system of the 50's generally ran one job at a time. These were called single-stream batch processing systems because programmes and data were submitted in groups or batches.

Third Generation (1960s)

The systems of the 1960's were also batch processing systems, but they were able to take better advantage of the computer's resources by running several jobs at once. So operating systems designers developed the concept of multiprogramming in which several jobs are in main memory at once; a processor is switched from job to job as needed to keep several jobs advancing while keeping the peripheral devices in use.

For example, on the system with no multiprogramming, when the current job paused to wait for other I/O operation to complete, the CPU simply sat idle until the I/O finished. The solution for this problem that evolved was to partition memory into several pieces. With a different job in each partition. While one job was waiting for I/O to complete, another job could be using the CPU.

Another major feature in third-generation operating system was the technique called spooling (simultaneous peripheral operations online). In sopooling, a high speed device like a disk interposed between a running programme and a low-speed device involved with the programme in input/output. Instead of writing directly to a printer, for example outputs are written to the disk. Programmes can run to completion faster, and other programmes can be initiated sooner when the printer becomes available, the outputs may be printed.

Another feature present in this generation was time-sharing technique, a variant of multiprogramming technique, in which each user has an on-line (i.e., directly connected) terminal. Because the user is present and interacting with the computer, the computer system must respond quickly to user requests, otherwise user productivity could suffer. Timesharing systems were developed to multiprogramme large number of simultaneous interactive users.

Fourth Generation (1970s)

With the development of LSI (Large Scale Integration) circuits, chips, operating system entered in the personal computer and the workstation age. Microprocessor technology evolved to the point that it becomes posible to build desktop computers as powerful as the mainframes of the 1970s. Two operating systems have dominated the personal computer scene : MS-DOS, written by Microsoft, Inc. for the IBM PC and other machines using the Intel 8088 CPU and its successors, and UNIX, which is dominant on the large personal computers using the Motorola 6899 CPU family.

10.1.3 Classification of Operating Systems

Operating systems may be classified by both how many tasks they can perform 'simultaneously' and by how many users can be using the system 'simultaneously'. That is : single-user or multi-user and single-task or multitasking. A multi-user system must clearly be multi-tasking. The table below shows some examples.

OS	Users	Tasks	Processors
MS/PC DOS	S	S	1
Windows 3x	S	QM	1
Macintosh System 7.*	S	QM	1
Windows9x	S	M*	1
UNIX/LINUX	M	M	n
NT	S/M	M	n
Windows 2000	M	M	n

The first of these (MS/PC DOS/Windows 3x) are single user, single-task systems which build on a ROM based library of basic functions called the BIOS. Only a single user application could be open at any time. Windows 95 replaced the old co-routine apporach of quasi-multitasking with a true context switching approach, but only a single user system, without memory protection. Windows NT added a proper kernel with memory protection, based on the VMS system, originally written for the DEC/Vax.

Later versions of Windows NT and Windows 2000 (a security and kernel enhanced version of NT) allow multiple logins also through a terminal server. Windows 2000 thus has comparable functionality to Unix in this respect.

Windows 9x is purported to be preemptive multitasking but most programme crashes and also crash the entire system. This might be due to the lack of proper memeory protection. The claim is somewhat confusing.

Unix is arguably the most important operating system today. It comes in many forms, developed by different manufacturers. Originaly designed at AT & T, UNIX split into two camps early on : BSD (Berkeley software distribution) and system 5 (AT&T license). A standardization committee for Unix called POSIX, formed by the major vendors, attempts to bring compatibility to the Unix world.

10.1.4 Types of Operating Systems

Operating systems are divided into categories that define their characteristics. Modern systems may use combinations of those described below.

Batch	The earliest type, allowed only one programme to run at a time. The programme was entered into the computer, then run till completed. The data used by the programme could not be modified whilst the programme was running. Any errors in the programme or data mean starting all over again.
Inter-Active	These allow the modification and entry of data whilst the programme is running. Typical systems are airline reservations and languages such as BASIC.
Time-Sharing/Multi-user	These share the computer system amongst more than one user, and employ pre-emptive scheduling techniques.
Multi-Tasking	More than one process may be executed at once. The processor is switched rapidly between the processes. A user may run more than one process at a time.
Real-Time	Primarily used in process control, telecommunications, etc. The OS monitors various inputs which affect the execution of processes, changing the computers model of the environment, thus affecting the outputs, within a guaranteded time period (usually < 1 second).
Multi-Processor	A computer that has more than one processor dedicated to running processes.
EMBEDDED	An embedded operating system means the operating system is self-contained in the device and resident in ROM. Typical systems that use embedded operating systems ae household appliances, car management systems, traffic control systems and energy management systems.

10.1.5 Loading of an Operating System (Booting)

The operating system may be loaded into the computers memory in two ways.

1. It is already present in ROM (so is permanent, immediately accessible and difficullt to update)

2. It is loaded from disk when the computer is turned on.

If the operating system is already present in ROM (for systems like industrial controllers, petrol pumps etc), it will gain control immediately the processor is powered on. This method is best suited for small appliances and hand held devices where the operating system is relatively simple and small.

For more complex systems, the operating system is usually stored on secondary media (such as disk), and is loaded into the computer memory (RAM) when the computer is powered on. Advantages of this type of system are that changes to the operating system are easier to make and implement.

When user turn on the power to a computer, the first programme that runs is usually a set of instructions kept in the computer's read-only memory (ROM). This code examines the system hardware to make sure everything is functioning properly. This power-on self test (POST) checks the CPU, memory, and basic input-output systems (BIOS) for errors and stores the result in a special memory location. Once the POST has successfully completed, the software loaded in ROM (sometimes called the BIOS or firmware) will begin to activate the computer's disk drives. In most modern computers, when the computer activates the hard disk drive, it finds the first piece of the operating system : the bootstrap loader.

10.1.5.1 Bootstrap Process

The bootstrap loader is a small programme that has a single function. It loads the operating system into memory and allows it to begin operation. In the most basic form, the bootstrap loader sets up the small driver programmes that interface with and control the various hardware subsystems of the computer. It sets up the divisions of memory that hold the operating system, user information and applications. It establishes the data structures. Then it turns control of the computer over to the operating system.

The bootstrap process describes the task of initially loading the operating system from disk into RAM. A small routine stored in ROM, called the BOOTSTRAP LOADER or IPL (Intial Programme Loader), reads a special load routine from the diskette.

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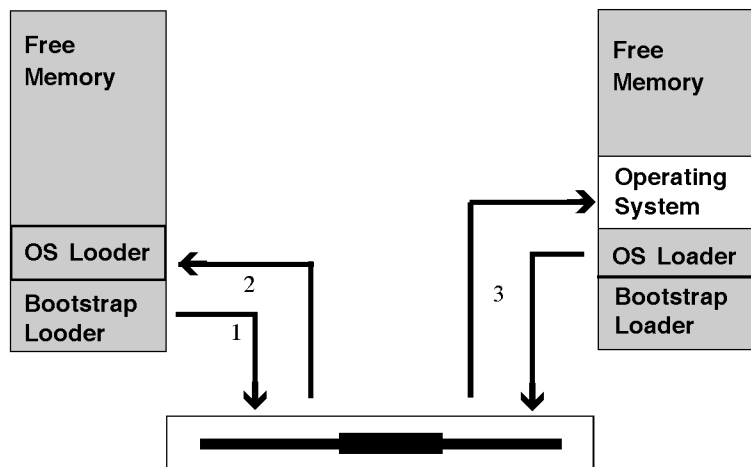
1: Request OS Loader routine from disk unit
2: Transfer OS loader into memory
3: OS loader loads rest of OS into memory

In floppy based system, this routine is normally located on Track 00, sector 00 (or 01), and is called the boot sector. The code contained in the sector is transferred into RAM, and then executed. It has the sole responsibility for loading the rest of the operating system into memory.
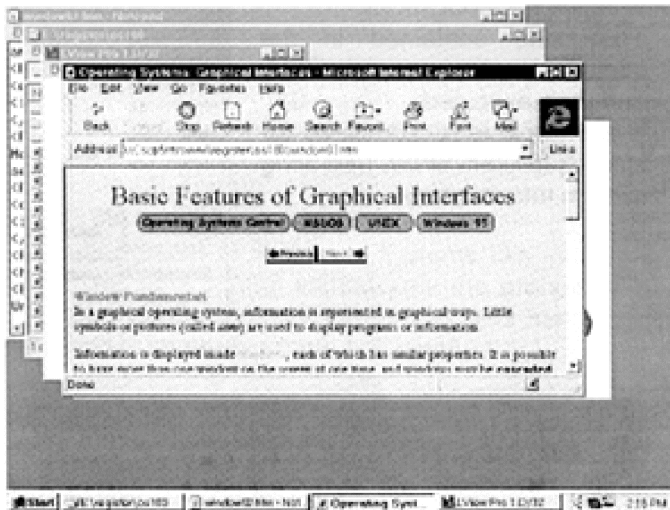
10.2 Single User Operating System : MS-WINDOWS

Operating systems such as Windows 95, Windows NT Workstation and Windows 2000 professional are essentially single user operating systems. They provide the capability to perform tasks on the computer system such as writing programmes and documents, printing and accessing files.

In essence, a single-user operating system provides access to the computer system by a single user at a time. If another user needs access to the computer system, they must wait till the current user finishes what they are doing and leaves. The Windows operating system supports the following file systems.

FAT	The MS-DOS operating system introduced the File Allocation Table system of keeping track of file entries and free clusters. Filenames were restricted to eight characters with an addition three characters signifying the file type. The FAT tables were stored at the begining of the storage space.
FAT32	An updated version of the FAT system designed for Windows 98. It supports file compression and long filenames.
NTFS	Windows NT introduced the NT File System, designed to be more efficient at handling files than the FAT system. It spreads file tables throughout the disk, beginning at the center of the storage space.

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10.2.1 Window Fundamentals

In a graphical operating system, information is represented in graphical ways. Little sysmbols or pictures (called icons) are used to display programmes or information. Information is displayed inside windows, each of which has similar properties. It is possible to have more than one window on the screen at one time, and windows may be cascaded (on top of one another) or tiled (all displayed at once and all visible).

In this picutre, the windows have been cascaded. This makes each window appear on top of each other, one after the other.

The front most window is considered to be the active window, i.e., the window to which the users commands will be sent.

In Windows95 or WindowsNT, the title bar of the window is shown in the default color Blue.

In this picture, the images have been tiled. This makes all windows visible at the same time, but resizes the dimensions of each window so that they all fit on the available screen space at once.

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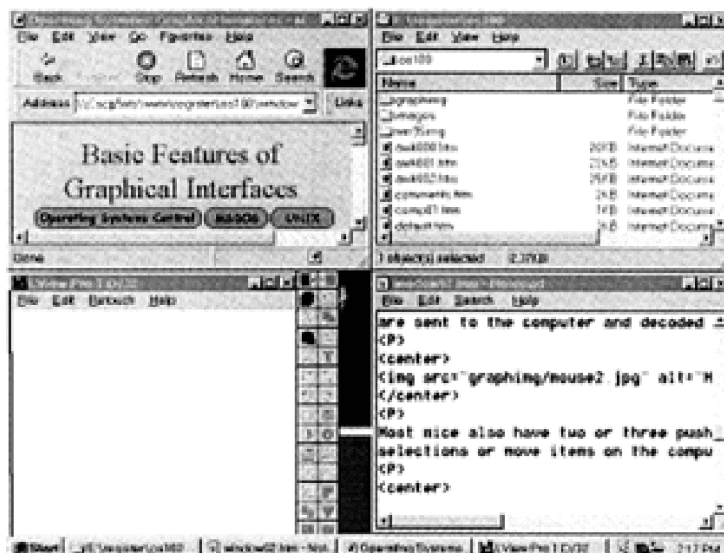
To cascade or tile all windows on the desktop area, right mouse click on an empty portion of the taskbar and select cascade Windows or Tile Windows from the menu.

10.2.2 Window Properties

Each window has the same properties and behaves the same way. This provides a consistent interface to the user, as all commands are the same for each window and the operations that the user performs on each window are indentical. In the diagram below, we see the basic window as presented by Windows 95 or Windows NT. Each property is listed on the diagram, and below is an explanation for each of the window components.
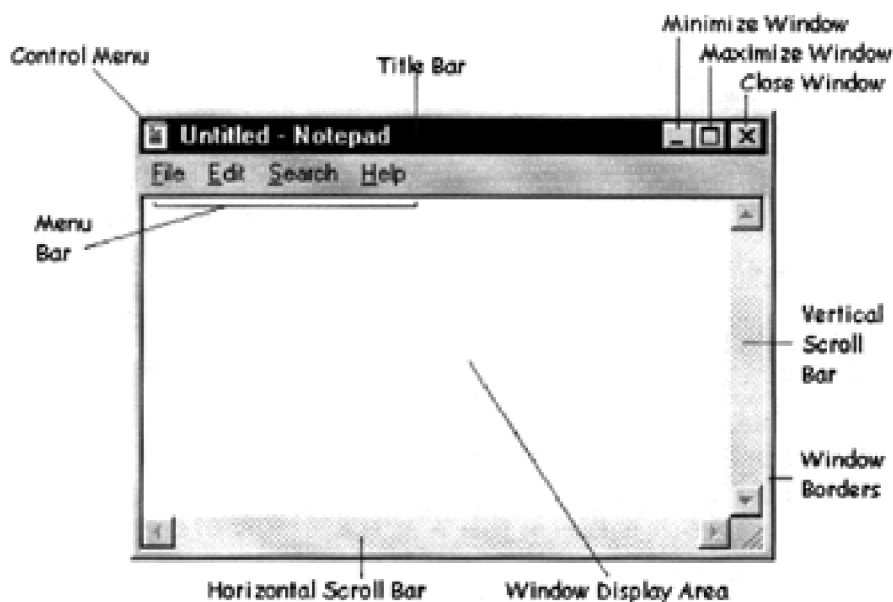
10.2.2.1 The Title Bar

This normally displays the name of the programme associated with the window. If the background color of the title bar is blue, the window is active and any user commands will be processed by that window. You can also toggle between a maximized window size and the windows normal size by double clicking in the title bar area.

10.2.2.2 The Control Menu

Clicking on the Control Menu pops up a small Window of selectable options, which include the operations of Restore, Move, Size, Maximize, Minimize and Close the Window.

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10.2.2.3 The Horizontal and Vertical Scroll Bars

When the amount of information displayed in the window exceeds the viewing space of the window, scroll bars are automatically to the side and bottom of the window. This allows the user to scroll the contents of the window in order to view the remaining information. Arrows are used to indicate the direction of scrolling on the scroll bar, and an indicator bar represents the relative position of the viewing area compared to the total size of the information.

Clicking on the arrows associated with the scroll bar move the viewing window up or down one line, or across or back one character position. You can also click on the small indicator bar within the scroll bar and drag it with the mouse to quickly scroll the windows contents.

10.2.2.4 The Minimize Maximize Close Window Buttons

These buttons are located on the top right corner of each window. Clicking on them once performs the desired action associated with the button.

- The minimize button ⊟ reduces the window and places it on the taskbar at the bottom of the window.

- The maximize button ☐ expands the window to fill the entire desktop screen area.

- The close button ☒ closes the window.

To minimize all windows on the desktop area, right mouse click on an empty portion of the taskbar and select Minimize all Windows from the menu.

10.2.2.5 Menu Bar

The menu bar presents a number of options that the programme associated with the Window supports. On clicking an option on the menu bar will popup a submenu of choices that user can select from.
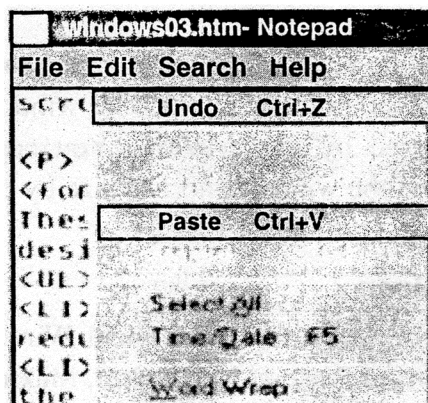
10.2.2.6 The Windows Borders

The windows borders show the dimensions of the window. Any window can be resized, either made smaller or larger, by dragging the window border appropriately.

- To make the window taller or shorter : Move the mouse pointer to either the top or bottom window border, and when it changes to a resize arrow ↔, then hold the left mouse button down and drag the window border to its new position, then let release the left mouse button.

- To make the window narrower or wider : Move the mouse pointer to either the left or right window border, and when it changes to a resize arrow ↕, then hold the left mouse botton down and drag the window border to its new position, then let release the left mouse botton.

10.2.2.7 Moving a Window

A window can be repositioned on the desktop screen display area by moving the mouse cursor into the title bar area, then holding the left mouse button down and dragging the window to the new position, then releasing the left mouse button.

10.2.2.8 Switching between Windows

Switching between windows is possible by clicking on the programmes icon on the taskbar or pressing ALT-TAB keys on the keyboard. When you press ALT-TAB, it will pop up a window of the available programmes. Hold the ALT key down, and pressing the tab key will move the selection to the next window in the list. When the desired window is highlighted, release the ALT key and that window will become active.

Clicking on the applications icon on the taskbar can also do switching to another application. The following picture shows the Windows taskbar, located at the bottom of the screen.
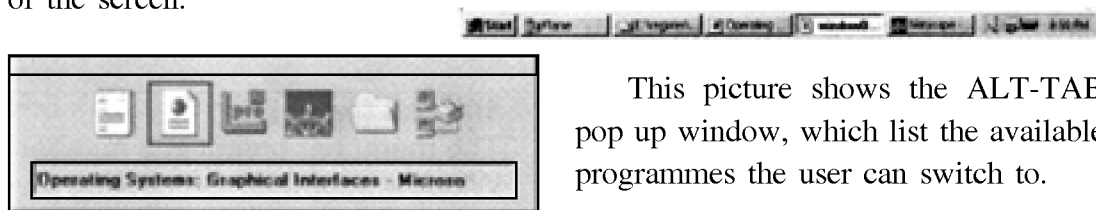
This picture shows the ALT-TAB pop up window, which list the available programmes the user can switch to.

10.2.3 Window objects and components

This section discusses window options such as buttons and dialog boxes.

10.2.3.1 Text Boxes

Text boxes allow you to enter text information. To enter text, first click inside the text area using the mouse, and the cursor will change to a vertical flashing bar |

showing you that text box allows the user to specify a file to find on the computer. The name of the text box entry field is called Named :
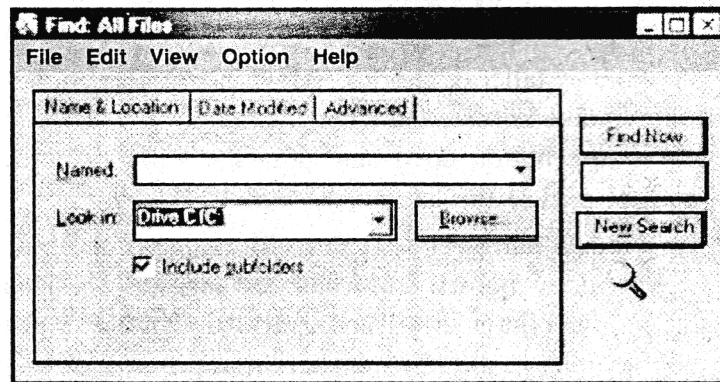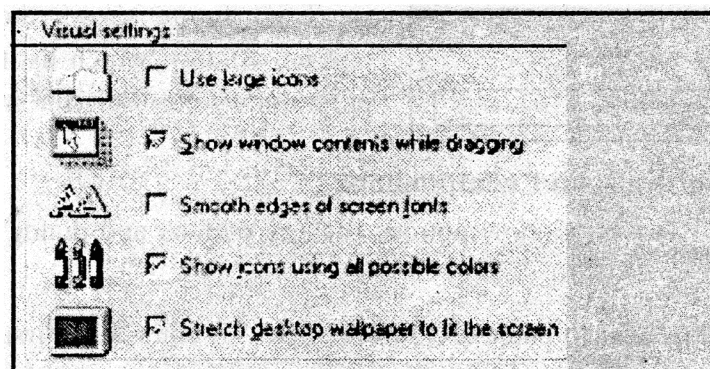

10.2.3.2 Radio Buttons

Radio buttons allow users to select one of a number of options from a selection. In the following image, a choice between Tiled and Centered is offered. A radio button is enabled when there is a black dot in its center. A radio button is disabled when it is empty. To enable a radio button, simply click once on it. To disable a radio button that is enabled, simply click once oni it. It works like a toggle switch.

10.2.3.3 Check Boxes

Check boxes allow users to select one or more options from a selection. In the following image, the options Show window contents while dragging, Show icons using all possible colors and Stretch desktop wallpaper to fit the screen are all enabled.

A check box is enabled when it has a tick in it, when a check box is empty, that option is not selected. To enable a check box, simply click once on it. To disable a check box that is enabled, simply click once on it. It works like a toggle switch.
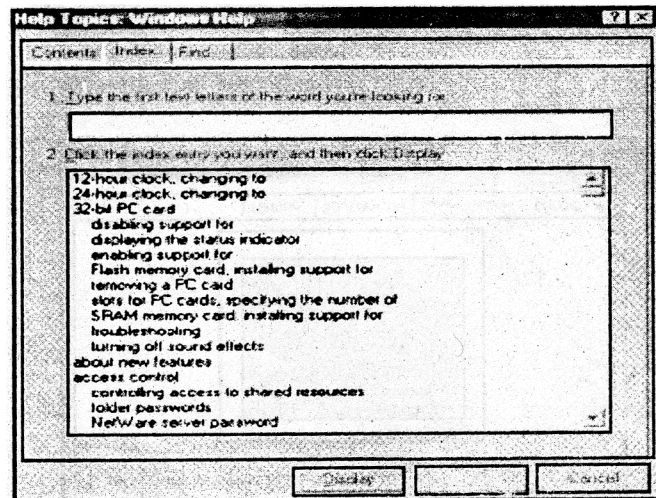
10.2.3.4 Dialog Boxes

Dialog boxes allow you to make choices and enter data. They combine text boxes with radio buttons and check boxes.
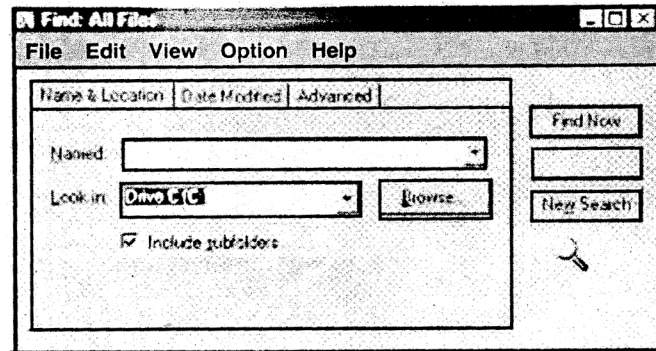
To close a dialog box, press the ESC key.

10.2.3.5 List Boxes

List boxes present a number of choices. You select one by double-clicking on the item you want. Often the list of choices is in a scrollable window box.


In this example, the Help dialog box of Windows lists a number of help topics that the user can double-click on to reveal the help associated with that item.

10.2.3.6 Drop down List Boxes

To minimize the amount of screen space, list boxes can sometimes be arranged as a drop down list box. This displays a single item, but when the list box is clicked on, the range of items pops up in a secondary window.

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A drop down list box is shown below. In this example, it is part of the Dialog box associated with the Display Properties.
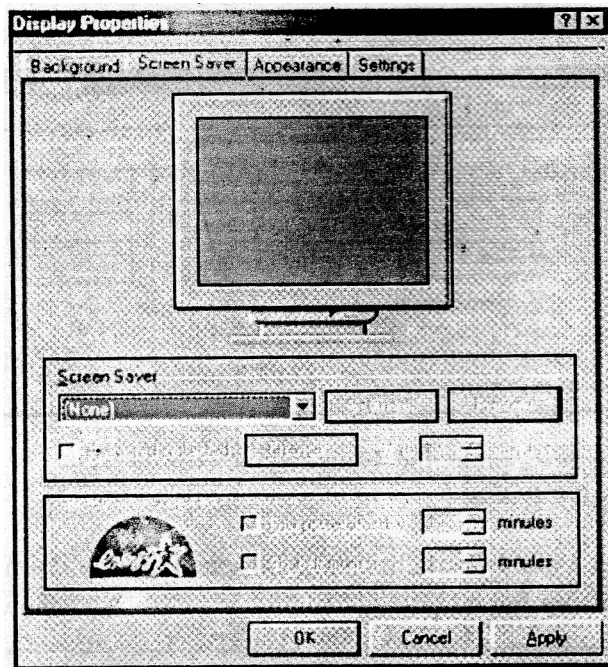

Notice the sysmbol at the end of the box. Clicking on this symbol reveals the list of options.
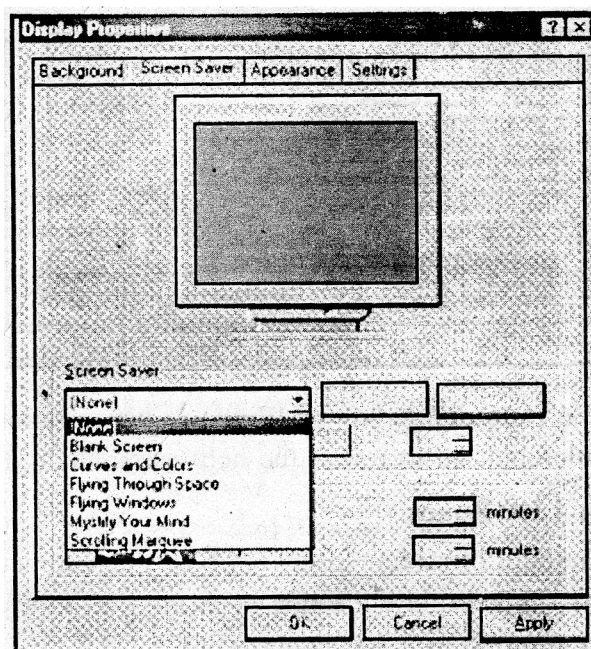
10.2.3.7 Tab Controls

Tab controls allow a number of different dialog boxes associated with a device to be presented as a single combined control. For instance, if we looked at the screen display in Windows, there are so many things that can be changed, like screen saver, wall-paper, size and resolution, video display driver and so on.

Putting all of these on a single dialog box is cumbersome and there is just not enough screen real estatle, so, a number of dialog boxes are used, but they are combined using the tab control. It looks like multiple sections, and each tab has a heading. Clicking on the tab item reveals the dialog box associated with that tab.
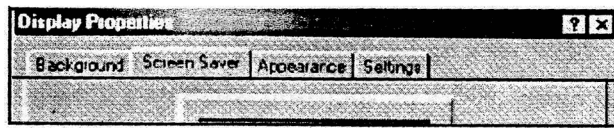
In this example, the tab control for the Windows desktop properties is displayed. Note there are FOUR distinct dialog boxes : the current choice is Screen Saver.

10.2.3.8 Toolbars

Toolbars appear on a number of windows and application programmes. An example is the My computer window.
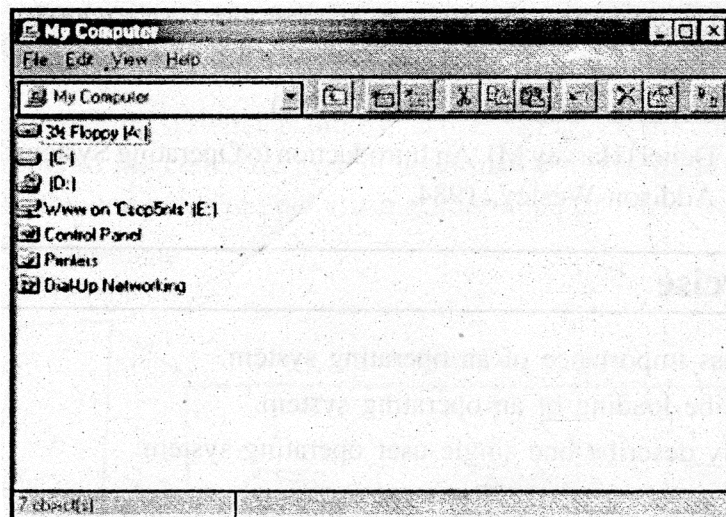
The toolbar is displayed underneath the Menu Bar Options of the window. An expanded view looks like

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The toolbar consists of a number of icons (little pictures), each representing a command. As the mouse cursor is moved along each icon, a text description will pop up revealing the available control that is underneath the mouse cursor.
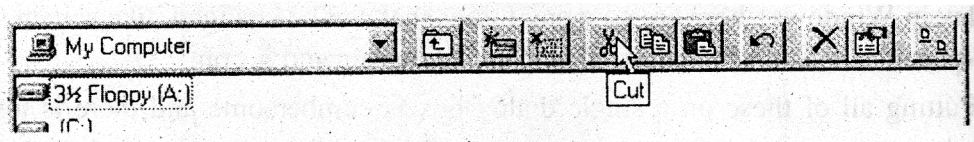
Toolbars provide shortcuts to regularly used operations like cut paste, close, and help.

References and Further Readings

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5   2000   Brown (Brain). Operating system introduction, v4.0. (http://goforit. unk. edu/opsys/default.htm). 2000.

6   1984   Deitel (Harvey M). An Introduction to Operating System. Massachusetts : Addison-Wesley, 1984.

10.3 Exercise

1. Discuss importance of an operating system.
2. Describe loading of an operating system.
3. Briefly describe one single user operating system.

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