

Unit 6

Computer Software

Introduction

Computer Hardware

All the electronic devices which we can touch & feel are called computer hardware. As for example, hard disk, CPU, RAM, ROM Motherboard etc.

Computer Software

Computer Software

A computer needs both **hardware** and **software** for its proper functioning. Hardware (components like input, processing, output, and storage that can be physically handled) alone cannot perform any particular function without software.

OR

Software is a programs, procedures, routines and set of instructions.

Computer Software

Firmware

Firmware are also software(program or data) that has been permanently written onto ROM.

Computer Software

Classification of Software

- System Software
- Application Software

Classification of software

System Software

System software is a collection of programs which control the operation of the computer. It is also known as operating system. As for example windows,vista,unix,linux etc.

System software can be divided into three ways.

- Language Processors
- Operating systems
- Utility programs

System Software

Language Processor

We have to convert source code into object code, we need a language processor. Source code is high level language/Assembly language. Object code is machine language or machine code.

Language processor can be divided into three types.

- Compiler
- Interpreter
- Assembler

System Software

Language Processor

- Compiler can translate source code into object code one at a time. It may take short time. So, it is faster than interpreter.
E.g. C,C++,JAVA,COBOL,FORTRAN etc.
- Interpreter can translate source code into object code one by one. It may take long time. So, it is slower than the compiler.
E.g. BASIC,PERL.
- Assembler is also a translator which translates the program written in assembly language. E.g. mnemonics code

Language Processor

Linker

is a program that links several object modules and libraries to a single executable program. A source code of a program is often very large consisting of several hundred or more lines. The code is broken down into many independent modules for easy debugging and maintenance.

Language Processor

Loader

- The loader software is used to load and re-locate the executable program in the main memory. Software has to be loaded into the main memory during execution. Loader assigns storage space to the program in the main memory for execution.

System Software

Operating Systems

are the most important programs that run on a computer. An operating system manages and coordinates the functions performed by the computer hardware. Most commonly used operating systems include Microsoft Windows, MS-DOS, UNIX, Solaris etc.

System Software

System Utility or Utility programs

are a set of programs that helps users in system maintenance, disk formatting, data compression, data backup & scanning computer virus etc.

System utility software is required for the maintenance of computer. System utilities are used for supporting and enhancing the programs and the data in computer. Data Compression utility to compress the files.

System Software

- Some system utilities may come embedded with OS and others may be added later on. Some examples of system utilities are: Anti-virus utility to scan computer for viruses.

Application Software

Application software is a set of programs designed to solve a specific task. Application software can be a program used for accounting control in business, a program used for engineering design etc. Some application software are

- Word processors software
- Spreadsheets software
- Presentation software
- Database software

Application software

Application software is two types

- Standard or package or generic software

E.g. Microsoft Office, Tally, Fact etc.

- Customized or unique software

The software which are designing individual customer requirements is called customized software. E.g. school billing system, accounting software, calculator etc.

Software Acquisition

- Different kinds of software are made available for use to users in different ways. The user may have to purchase the software, can download for free from the Internet. Nowadays with the advent of Cloud computing, many application software are also available on the cloud for use through the Internet, e.g. Google Docs. The different ways in which the software are made available to users are:
- Retail Software is off-the-shelf software sold in retail stores. It comes with printed manuals and installations.

Software Acquisition

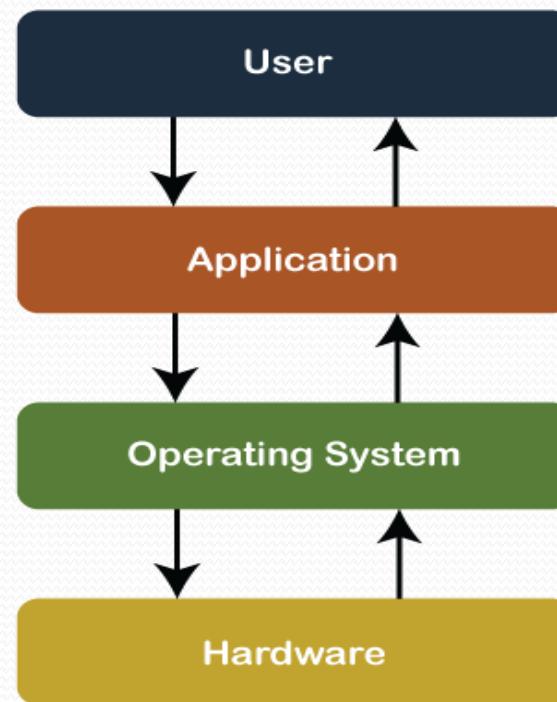
- OEM Software stands for “Original Equipment Manufacturer” software. It refers to software which is sold and bundled with hardware.
- Demo Software is designed to demonstrate what a purchased version of the software is capable of doing and provides a restricted set of features. To use the software, the user must buy a fully-functional version.
- Shareware is a program that the user is allowed to try for free for a specified period of time as defined in.
- Freeware is software that is free for personal use. It is downloadable from the Internet. The commercial use of this software may require a paid license.

Operating System

Introduction

Operating system is a set of programs that controls the resources of a computer system & provides with an interface for the users. An operating system manages all the resources of a computer system. It controls, co-ordinates the overall operation of a computer system. E.g. Ms-DOS ,Windows-XP ,Vista ,Unix , Linux ,Solaris, Android etc.

Operating System



Objectives of Operating System

- OS provides interface for the users.
- OS manages resources of the computer system like input devices, output devices, CPU, storage etc.
- OS can scheduling different resources of the computer system.

Functions of an operating system

- User interface or command interpreter
- Device management
- Memory management
- Process management
- File management
- Protection & security

Functions of an operating system

User interface

The operating system acts as an interface between user & hardware. An operating system interact hardware & users & to provide working environment for the users. There are two types of user interface.

- CUI E.g. MS - DOS, UNIX &
- GUI E.g. Windows 95, 98, 2000,XP, Vista & Linux etc.

Function of an Operating System

Device management

OS manages & allocates computer resources such as CPU ,memory ,input & output devices etc.

The device management tasks handled by OS are—(1) open, close and write device drivers, and (2) communicate, control and monitor the device driver.

Function of an Operating System

Memory management

Memory management takes care of allocation & de allocation of memory space to programs. OR

The activities of memory management handled by OS are—(1) allocate memory (2) free memory (3) re-allocate memory to a program when a used block is freed and (4) keep track of memory usage.

Function of an Operating System

Process management

Process management takes care of creation & deletion of process, scheduling of system resources to different processes requesting them & providing mechanism for communication among processes.

Functions of Operating System

File management

File management takes care of file related activities such as organization, storage, retrieval, naming, sharing & protection of files.

Protection and security

Protection & security module protects the resources & information of a computer system against destruction & unauthorized access.

Process Management

- A process is a program in a state of execution. It is a unit of work for the operating system. A process can be created, executed, and stopped. In contrast, a program is always static and does not have any state. A program may have two or more processes running. A process and a program are thus two different entities.

Process Management

- The process management function of an operating system handles allocation of resources to the processes in an efficient manner. The allocation of resources required by a process is made during process creation and process execution.
- A process changes its state as it is executed. The various states that a process changes during execution are as follows .

Process States

- New—process is in a new state when it is created.
- Ready—process is in ready state when it is waiting for a processor.
- Running—process is in running state if processor is executing the process.
- Waiting—process is in waiting state when it waits for some event to happen (I/O etc.) and
- Terminated—process that has finished execution is in terminated state.

CPU Scheduling

- CPU or processor is one of the primary computer resources. All computer resources like I/O, memory, and CPU are scheduled for use.
- CPU scheduling is important for the operating system. In a multiprogramming and time sharing system, the processor executes multiple processes by switching the CPU among the processes, so that no user has to wait for long for a program to execute. To enable running of several concurrent processes, the processor time has to be distributed amongst all the processes efficiently.

Process Scheduling

- Scheduling can be non-pre-emptive scheduling or pre-emptive scheduling. In non-preemptive scheduling, the processor executes a process till termination without any interruption. Hence the system resources are not used efficiently. In pre-emptive scheduling, a running process may be interrupted by another process that needs to execute. Pre-emption allows the operating system to interrupt the executing task and handle any important task that requires immediate action. In pre-emptive scheduling, the system resources are used efficiently.

Process Scheduling

- There are many different CPU scheduling algorithms that are used to schedule the processes. Some of the common CPU scheduling algorithms are as follows—
- First Come First Served (FCFS) Scheduling: As the name says, the process that requests for the CPU first, gets the CPU first. A queue is maintained for the processes requesting the CPU. The process first in the queue is allocated the CPU first. FCFS scheduling is non-pre-emptive.
- Shortest Job First (SJF) Scheduling: The process that requires the least CPU time is allocated the CPU first. SJF scheduling is non-pre-emptive.

Process Scheduling

- Round Robin (RR) Scheduling: It is designed for time-sharing systems. RR scheduling is pre-emptive. In this scheduling, a small quantum of time (10–100 ms) is defined, and each process in the queue is assigned the CPU for this quantum of time circularly. New processes are added at the tail of the queue and the process that has finished execution is removed from the queue. RR scheduling overcomes the disadvantage of FCFS and SJF scheduling.

Process Synchronization

- In a computer, multiple processes are executing at the same time. The processes that share the resources have to communicate with one another to prevent a situation where one process disrupts another process.

Deadlock

In a multiprogramming environment, multiple processes may try to access a resource. A deadlock is a situation when a process waits endlessly for a resource and the requested resource is being used by another process that is waiting for some other resource.

A deadlock arises when the four necessary conditions hold true simultaneously in a system. These conditions are as follows:

Deadlock

- Mutual Exclusion—Only one process at a time can use the resource. Any other process requesting the resource has to wait until the resource is released.
- No Pre-emption—A process releases the resource by itself. A process cannot remove the resource from another process.
- Hold and Wait—A process holds a resource while requesting another resource, which may be currently held by another process.
- Circular Wait—in this situation, a process P1 waits for a resource held by another process P2, and the process P2 waits for a resource held by process P1.

Deadlock

- Deadlock handling can be done by deadlock avoidance and deadlock prevention.
- Deadlock Prevention is a set of method that ensures that at least one of the above four necessary conditions required for deadlock does not hold true.
- Deadlock Avoidance requires that the operating system be given information in advance regarding the resources a process will request and use. This information is used by the operating system to schedule the allocation of resources so that no process waits for a resource.

Memory Management

In a computer, there may be multiple processes executing at the same time. Every process that needs to execute, requires a certain amount of memory. Memory management is one of the tasks handled by the operating system. Memory management schemes handle the allocation of memory to different processes. On completion of process execution, the memory is de-allocated and made available to another process. This requires some memory protection and sharing mechanism. Now we will discuss memory allocation, de-allocation, reallocation of free memory and memory protection and sharing.

Memory Allocation

- In single-user and single-task operating system like MS-DOS, only one process can execute at a time. After the termination of the process, the allocated memory is freed and is made available to any other process.
- In a multiprogramming system, in addition to allocation and de-allocation of memory, more tasks are involved like keeping track of processes allocated to the memory, memory protection and sharing etc.
- There are different memory allocation schemes to allocate memory to the processes that reside in memory at the same time. The different memory allocation schemes are as follows.

Memory Allocation

- Multiple Partition Allocation—The operating system keeps track of blocks of memory which are free and those which are unavailable. The single block of available memory is called a hole. When a process requires memory, a hole large enough for the process is allocated. As different processes release the memory, the released block of memory is placed in the set of holes. During allocation of memory, the set of holes is searched to determine which hole is to be allocated. For this, three hole allocation strategies are used—(1) first-fit (allocate the first hole that is big enough for the process, (2) best-fit (allocate the smallest hole that is big enough for the process, and (3) worst-fit (allocate the largest available hole).

Memory Allocation

- Paging—In paging, the physical memory is broken into fixed size blocks called frames. This is the primary memory allocated to the process. The logical memory is broken into blocks of the same size called pages. Generally pages are of sizes varying from 1 KB to 8 KB. When a process is executed, its pages are loaded into the frames.

Memory Allocation

Virtual Memory

- In the memory management schemes discussed in the previous section, the whole process is kept in memory before the execution starts. However, for some applications, large memory is required to run the applications and the whole program cannot be loaded into the memory.
- Virtual memory allows the execution of those processes that are not completely in memory.
- Virtual memory is commonly implemented by demand paging. Demand paging is similar to paging with swapping. Swapping is transferring of block of data from the on-line secondary storage like hard disk to the memory and vice versa.

File Management

The file management function of the operating system involves handling the file system which consists of two parts—a set of files and a directory structure.

File is a collection of related information, has a name, and is stored on a secondary storage. It is the smallest named unit that can be written to a secondary storage device. Data cannot be stored on the secondary storage if it is not in the form of a file. A file has attributes like its name, location, size, type, time and date of creation etc.

Device Management

- Several peripheral devices like mouse, hard disk, printer, plotter etc. are connected to the computer. The peripheral devices have varying characteristics like character or block device, sequential or random access device.
- OS manages and controls the devices attached to the computer. OS provides appropriate functionality to the application programs for controlling different aspects of the devices.

Device Management

- A device controller operates a port, bus, and a device. Device controller is just like a bridge between the device and the operating system. The device controller receives the data from a connected device, stores it temporarily, and then communicates the data to the devices device driver. Device driver is the software with which the device controller communicates with the operating system

Protection & Security

- Security mechanism prevents unauthorized access to the computer. Security concerns include— security of software, security of data stored in the computer and security of physical resources of the computer.
- In a personal computer, security can be ensured using—(1) user accounts—individual accounts for each user (2) user authentication—using password protection. (3) access rights—define rights for access of different kind of information for different people (4) data encryption—store data in computer in encrypted form and (5) data backup—storing data on a peripheral device other than the hard disk. Some of the common security threats occur due to hacking, viruses etc.

Types of operating system

Based on processing method

- Multitasking or multiprogramming
- Multiprocessing(Parallel Processing)
- Multithreading
- Time sharing
- Real time
- Batch

Types of Operating System

Based on User interface

- CUI(Character User Interface) &
- GUI(Graphical User Interface)

Based on Mode of user

- Single user &
- Multi user (Time sharing)

Types of Operating System

Multitasking (or multiprogramming)

Two or more tasks can be run one at a time in a single processor is called multitasking. As for example, a user of the computer can simultaneously play games while a word document is being printed(user is simultaneously working with two different applications(word & games). E.g. Unix, windows 95,98,2000,XP etc.

Types of Operating System

Multiprocessing(or Parallel Processing)

- Two or more programs, tasks or processes can be run one at a time in a multiple processor.
- Multiprocessing also refers to the utilization of multiple cpu's in a single computer system. This is also called parallel processing.

Types of Operating System

Multiprogramming

- **Multithreading**
- Single program called threads executed simultaneously. Multithreading is a form of multitasking that permits multiple parts of a software program to be run simultaneously. E.g. a user can perform a spell check in a word document & simultaneously print another word document.

Types of Operating System

Time sharing or Multiuser OS

The system that allows to use a single computer system by many users simultaneously is called time sharing.

Multiuser OS is used in computer networks that allow same data and applications to be accessed by multiple users at the same time. The users can also communicate with each other. Linux, UNIX and Windows 7 are examples of multiuser OS.

Types of Operating System

Real Time OS

are designed to respond to an event within a predetermined time. These operating systems are used to control processes. Processing is done within a time constraint. OS monitors the events that affect the execution of process and respond accordingly. They are used to respond to queries in areas like medical imaging system, industrial control systems etc. Lynx OS is an example of real time OS. Another example of real time OS are BLMX(Board level multitasking executive),internet, CTOS(Real time multitasking, multiprocessing OS for 8086 family).

Difference between Time sharing & Real time OS

- The user must receive a response within a specific time frame in the real-time operating system; otherwise, system failure is possible. In contrast, in the time-sharing operating system, the responses produce very quickly and hardly takes only a fraction of a second. If the response misses the time, the outcome is not disastrous.
- Many users share computer resources in Time-sharing operating systems, whereas external events are processed within a limit in real-time systems.

Difference between Time sharing & Real time OS

- There is only one application involved in real-time processing. In contrast, Time-sharing processing must deal with a wide range of applications.
- In the case of real-time operating systems, switching does not occur. On the other hand, the time-sharing operating system uses context switching to switch the CPU from one process to another.
- In RTOS, a computational task is completed in a specific amount of time, whereas in Time-Sharing operating systems, the emphasis is on responding quickly to a request.

Types of Operating System

Batch Operating System

- Some computer processes are very lengthy and time-consuming. To speed the same process, a job with a similar type of needs are batched together and run as a group.
- The user of a batch operating system never directly interacts with the computer. In this type of OS, every user prepares his or her job on an offline device like a punch card and submit it to the computer operator.

Types of Operating System

Based on user interface

- CUI

As for example MS –DOS, UNIX

- GUI

As for example Windows 95,98,2000,xp,vista,Linux etc.

Types of Operating System

Based on Mode of user

- Single user
- Multiuser (Time sharing)

Examples of operating system

- MS-DOS
- Windows
- Unix
- Linux

Examples of Operating System

MS-DOS

- Dos means Disk operating system. It is a single user operating system. It introduced in 1981(Microsoft & IBM).It is also known as CUI(Character User Interface).It is a text based operating system.

Examples of Operating System

Windows

- Windows operating system was developed by Microsoft. First successful version of this operating system was windows 1.0.
- After modifies this version and released successful version 3.0 in 1990.Later released versions were windows 95,windows 98,windows 2000,windows XP ,windows professional & windows vista.

Examples of Operating System

Windows

Main features of windows are given below.

- It is GUI. So, new user is easier to learn & use a computer system.
- It is a single user, multitasking operating system. Thus, more than one program can be run one at a time in a single processor.
- MS-Windows are complete operating system environment.

Open Source Operating System

UNIX

- Unix is a multiuser, time sharing operating system. Unix was developed in the early 1970's at Bell Laboratories by Ken Thompson & Dennis Ritchie for a PDP – 11 computer. It was the first operating system to be written in c language.

Open Source Operating System

Linux

The name “Linux” is derived from Linus Torvalds. Torvalds was a student at the University of Helsinki in Finland in early 1990's. He wrote the first version of an UNIX like kernel as a toy project. Later to make working system with many people in the world called Linux. It is an open – source network based operating system.

- First version 0.02 was first released in 1991 under GNU(General Public License).
- Then source code modified & released Linux version 1.0 in 1994.

Open Source Operating System

Advantages of Linux

- Linux is portable.
- Network based operating system.
- To provide better security.
- Linux is available freely.
- Flexible, reliable & comfortable.

New trends in software

- Open source software
- Cloud software
- Internet of Things(IOT)
- Big data
- Low code development